THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XIX. No. 465—22ND YEAR.] LONDON, AUGUST 2, 1870. [Subscription per Annum. { 15s. in Advance. 18s. Credit.] DOUBLE No. Price 1s.

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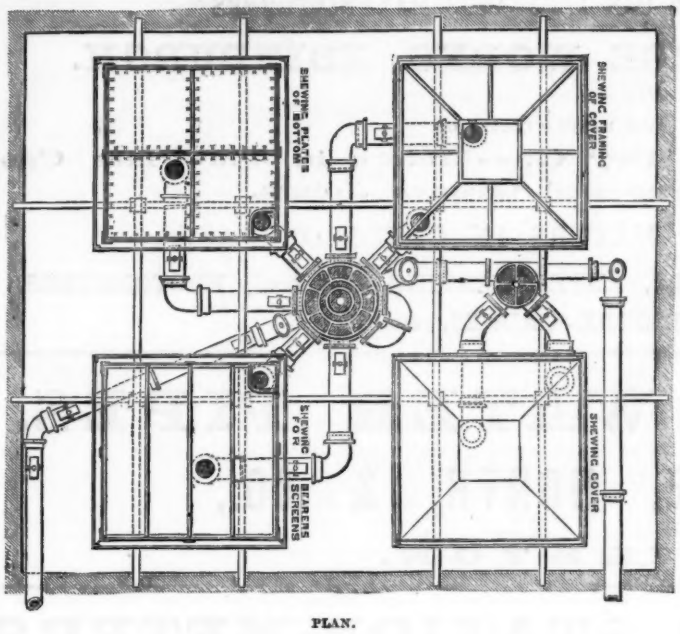

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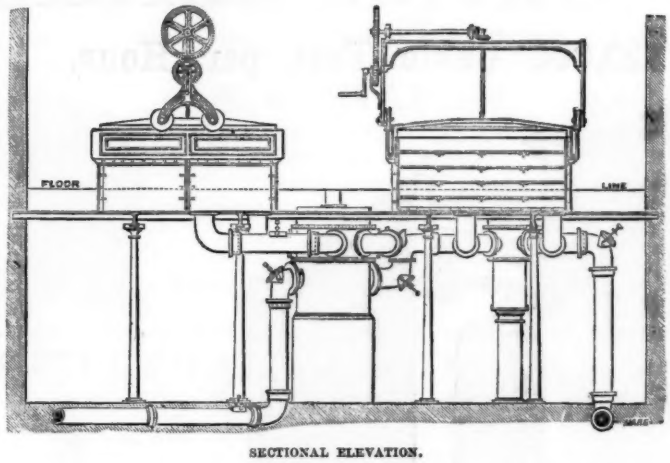

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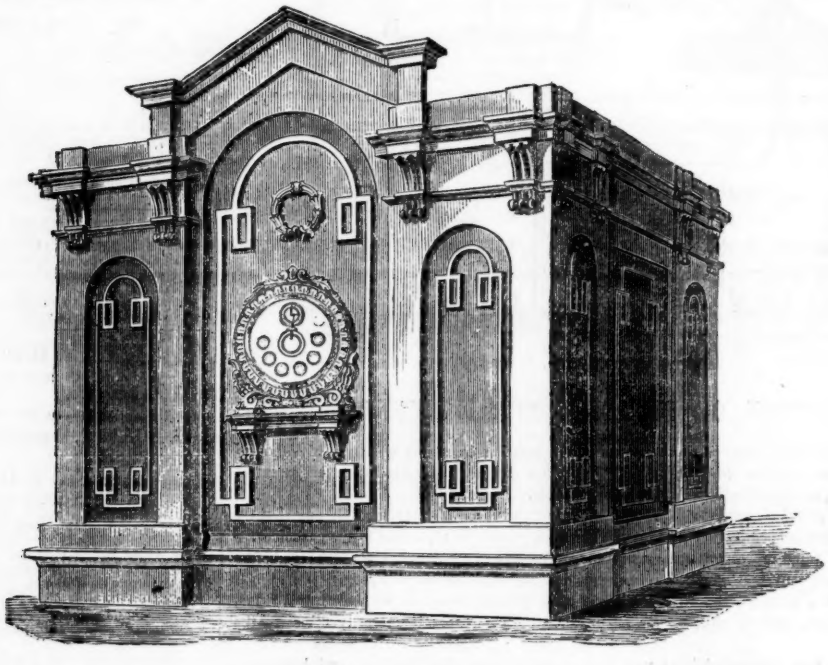

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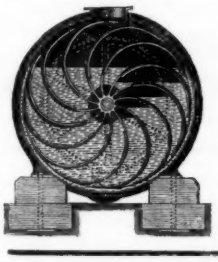

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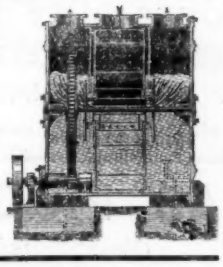

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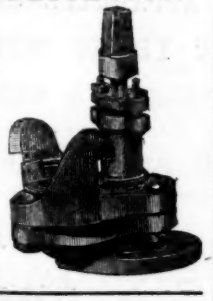

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Beg to inform Gas and Water Companies and the public, that they keep in stock in London all the CASTINGS in general use in Gas and Water Works, including Iron Retorts, Socket and Flange Pipes, Bends, Branches, and Syphons of all sizes, Lamp Columns, &c., &c.

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CELEBRATED SILKSTONE GAS COALS.

Analyses by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

Description.	Cubic Feet of Gas per Ton of Coals.	Illuminating Power in Candles.	Coke per Ton of Coal used. Cwt.	Ash in Coke per Cent.	Sulphur in Coal per Cent.
Best Silkstone . .	10,900	17·0	12·8	2·6	1·7
Norfolk Silkstone . .	11,000	15·94	12·5	4·4	1·64
Silkstone Brights . .	11,500	14·5	12·6	7·4	1·85
Silkstone Nuts . .	10,800	15·85	12·66	6·0	0·69

NOTE.—The illuminating power of the Gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

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FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER,

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

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IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS,

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And BIRMINGHAM (TANGYE BROTHERS), CORNWALL WORKS, SOHO.

SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS.

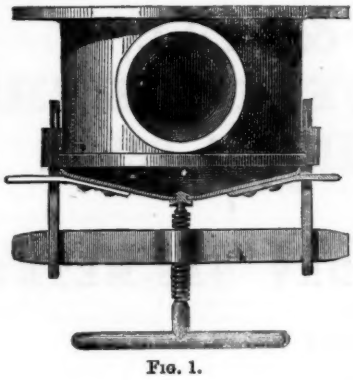

FIG. 1.

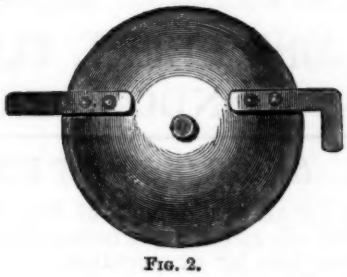

FIG. 2.

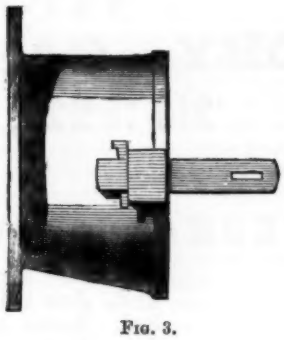

FIG. 3.

Several Hundreds in successful operation in various Gas-Works.

The expensive and cumbersome process of sealing the mouths of Gas-Retorts by means of luting the Lids with lime and other materials hitherto used for that purpose, is henceforth rendered unnecessary, and will be superseded by the very efficient method shown in the accompanying illustrations.

Fig. 1 shows a plan of a mouthpiece with Morton's Patent Lid in section. The mouthpiece is faced true, and the projecting circular edge or periphery of the lid is also turned true, and, by preference, of a semicircular section, so that the point of contact is reduced to a minimum; the convex form of the Lid rigidly sustains the force of the screw, which, by its central action, gives the Lid a uniform bearing, and effectually seals the mouth of the Retort.

Fig. 2 shows a front view of Morton's Patent Lid, which is stamped out of plate iron, having (in this case) ledges to rest on the lugs of the mouthpiece; these Lids, however, are more generally fitted to hinged cross-bars, by which means they remain suspended while the charge is withdrawn and the Retort charged, so that the damage done by throwing them about is entirely prevented.

The advantages obtained are—

1st. The sound sealing of the Retort during the whole time it is carbonizing the charge of coal, there being no jointing medium between the Lid and the mouthpiece.
2nd. The improved condition of the coke by the non-mixture of lime.
3rd. The Lid requires no preparation on the part of the stoker, beyond slightly scraping the surface to remove extraneous grit or dirt.
4th. The Lids are only about two-thirds the weight of the old form in general use, a Lid for a 16-inch mouthpiece weighing a little over 20 lbs.
5th. The Self-sealing Lid reduces labour, saves wear and tear, obviates all the inconvenience and discomfort consequent on the preparation of luting, and effects a great reduction in the working expenses. The cost attending the process of "luting" in several large gas-works, exceeds £1000 per annum, ranging in various works from 20s. to 35s. per mouthpiece.

It will be obvious that a round Lid is the most convenient and the cheapest form. D Retorts are adapted for round Lids, by carrying the bottoms down the necessary depth for that purpose, as shown in Fig 3. Some mouthpieces have been thus adapted, and are in use at the Chartered Gas-Works.

The following testimony speaks in favourable terms after ample and careful test:—

Burslem and Tunstall Gas Company, Longport, Staffordshire, Oct. 12, 1869.

Dear Sir,—In reply to your favour of the 9th inst., I have pleasure in stating that my admiration for your Patent Retort-Lid is most unqualified. I have 14 of them in use, and have tested them in the severest manner possible at these works, but without being able to detect the slightest defect. Yesterday the strap slipped off the exhauster, and a pressure of 13 inches was thus almost instantly thrown upon the Retorts, but although many of the luted Lids were leaking, not the slightest escape was observable from yours. I had anticipated that at least some greater degree of care would have been required in the scraping of the mouthpieces after the drawing of each charge, but even in this particular I find that labour has been reduced.

By every stoker on these works, as well as by myself, your Lids are regarded as a boon.

Please send me 30 more at your earliest convenience.

I am, &c., (Signed) HENRY WOODALL.

R. Morton, Esq.

Chartered Gas Company, Horseferry Road, Westminster, Sept. 15, 1869.

Dear Sir,—I have only lately returned to town, which is the reason I have not replied earlier to your inquiry.

I beg to say that I have had your Lids in use for upwards of two months, and during that time they have always kept a perfectly sound joint. I may add that where your lids are used only one set is required.

I remain, &c., (Signed) G. O. TREWBY.

R. Morton, Esq.

Chartered Gas Company, 146, *Goswell Street, E.C., Oct.* 20, 1869.

Dear Sir,—I have much pleasure in stating that, after some months trial of your Retort-Lids, I find them everything I could desire. I consider the plan a great improvement.

I am, dear sir, yours truly, (Signed) A. UPWARD.

R. Morton, Esq., London Gas Company.

These Lids are in successful use at the London Gas-Works, the Chartered Gas-Works, the Dublin Gas-Works, the Burslem and other Works, giving great satisfaction.

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TANGYE BROS. & HOLMAN, 10, Laurence Pountney Lane, London, E.C.

Sole Makers of Upward's Patent Safety Drilling Apparatus, Weston's Patent Differential Pulley Blocks, the "Special Steam-Pump," the Patent Duplex Lever Punch, &c.

London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865.

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PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters by the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS,

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON & CO.,

(SUCCESSORS TO SAMUEL CROSLEY,)

COTTAGE LANE, CITY ROAD, LONDON, E.C.

Established 1816.

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PATENT WET & DRY METERS,

STATION-METERS AND GOVERNORS,

PRESSURE REGISTERS, GAUGES,

EXPERIMENTAL METERS, PHOTOMETERS, GASHOLDERS, &c., &c.

WATER METERS.

W. P. & Co. beg to state that they are now prepared to supply Station-Meters with planed joints.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

NOTICES.

The subscription to the JOURNAL is 15s. per annum, if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, in July and January of each year. Post-Office orders should be made payable at the Money-Order Office, London, to William B. King, 11, Bolt Court, Fleet Street, by whom the business department of the JOURNAL is conducted.

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THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 2, 1870.

Notes upon Passing Events.

NOTES on Passing Events naturally include the subject of the war; at present confined to two of the greatest continental Powers, but destined, according to all historical precedents, to draw into its maëlstrom every European nation. What social or sanitary subject can be more urgent than the defence of our Commonwealth? The first question that naturally arises is, have we made use of all the mechanical and scientific powers within our reach to place our armaments by land and sea on the best possible footing for offence and defence, the first being an essential part of the second? We are afraid not. Yet our natural resources are unbounded. In mechanical genius, in manufacturing power, England holds the first rank. In a remarkable series of papers contributed some years ago to the *Revue des Deux Mondes*, on the Navies of Europe, the writer put down our Admiralty establishments as inferior to those of France. Perhaps they are since improved; but that's not much. He pointed out that the true strength of Great Britain lay in private enterprise, which could turn factories on the Thames, the Mersey, the Tyne, and the Clyde, into arsenals, with almost unlimited powers of production. At a critical moment Mr. Reed has retired from his naval dictatorship to the construction department at the Admiralty. We are not sorry for it. He is a clever, ingenious man, but his cleverness and ingenuity will be just as available to the nation, and more useful as chief in a department of Sir Joseph Whitworth's manufactory than in office, where he brought forward only his own designs, and used his utmost endeavours to burke or spoil those of Cowper Coles or any one else. We repeat, England requires for her armaments not one clever man, but the concentrated ability of all her sons, of every able inventor, British or foreign. We are strongly inclined to believe that Sir Joseph Whitworth has produced the only gun that can be relied on not to burst with heavy charges. The breech-loading apparatus of Sir William Armstrong and of every one else is notoriously a failure. It cannot be depended on in action. It is a parade contrivance. We say this with a full appreciation of the high mechanical ability of Sir William Armstrong. What we want at the Admiralty and the War Office are not inventors, but first-class mechanics and engineers, capable of disposing at a glance of the absurdities crowded on the attention of public departments—capable of distinguishing between the possible and impossible—experienced in manufacture. Such men are to be found amongst our engineers, civil and military. Their services are needed at once. The time for experiments has gone by. Our ships should be armed with guns in which the crews would have confidence; they have no confidence in the service guns, the production of all the talents of Woolwich. The small arm for our army should be selected, manufactured, and distributed, or we shall be caught while committees are still debating over the Martini-Henry, the Henry, the Spencer, and the Wesley Richards, and before our volunteers have had a chance of familiarizing themselves with breech-loaders. After all, the difficulty is in the want of men of sufficient capacity to direct our armaments. It is terrible to think of England in war with such a cipher of a Royal Duke Commanding-in-Chief—as a shield or screen—at the Horse Guards. Mr. Cardwell is everything that industry and common-place intelligence can make of an administrator; but whether he is strong enough and bold enough for War Minister, even with the assistance of Captain Vivian, may be doubted. It is the odd part of our system that, having men experienced in the art, science, and theory of war, they hold no responsible positions—if used at all are only used as private advisers of the civilians or military dummies in office. This sort of administration at the commencement of the Crimean War placed all the men like Sir Colin Campbell, who had seen service, and made war a profession, under the command of worn-out or mere parade officers. The departure of the French fleet, according to rumour, for operations on the northern coast of Germany will open the question of the powers of modern science for coast defences. We have heard a good deal lately of the improvements in torpedoes, to be worked by electricity. The Prussians are in possession of all the information and experience gained in the great American Rebellion. One of the most scientific inventors and manufacturers of electric and telegraphic apparatus is a German, long settled in England, who lately removed to Berlin to enjoy, in the more congenial society of his countrymen, the fruits of a large fortune earned in England. Prussia has no fleet that can contend with that of France, but we shall be surprised if the coast defences of Northern Germany do not display all the resources of modern science.

A parliamentary paper has lately been issued showing the progress of instruction in gymnastics in our army. The introduction of such teaching, as a system, originated in Germany, but it was the sight of French soldiers climbing up and disappearing over a lofty wall with all the ease and rapidity of rats that called the attention of influential military authorities to the necessity of adding gymnastic practice to drill, not only for the amusement, but for the use of British soldiers in hostile operations. It was time that full use should be made of the excellent raw material our commanding officers have in recruits. It is one of the accepted fallacies that the English soldier is naturally slow, heavy, and wanting in resources, yet it would be very easy to prove that such defects are the result of the system. As to contrivances for housing and cooking in campaigns, whole continents have been colonized by the British race. Whether the British emigrant has had to hew his way through forests or pitch his camp on the plains of Australia, he has never been found wanting in resources. The Anglo-Saxon is

essentially the model colonist. Again, our sailors are equally famous for their activity and their handiness as cooks, tailors, and settlers on wild shores. French soldiers are leavened by the traditions of the veterans of each regiment. The raw peasant is helpless enough, for in his home he has seldom had anything to cook. Again, as to athletic games, you may see more boys of the humblest class playing at foot-ball, running, trap-ball, cricket, and a hundred games of strength and skill, in one summer's day railway ride in England than in a whole year in France. There the peasantry work too long and too late to play; as for French boys, they seldom play at anything but soldiers. In this country the passion for athletic sports—for running, rowing, riding—so far from being confined to the easy classes, is universal, as any one may see who opens his eyes. What the English soldier needs is to be encouraged in those arts and those sports which will be useful in war. Curiously enough, it seems from the report that fencing is a very unpopular amusement amongst officers as well as men. The use of the sword, in these days of long-range rifles, is not of the importance it once was, but fencing amongst private soldiers should be encouraged, because it cultivates activity and gives exercise without quarrelling, as boxing with gloves is apt to do. This would best be done by money prizes of small amount for the best men with rapier and with single-stick.

The Commissioners of Sewers have taken a very remarkable step—whether in advance remains to be proved, but certainly in the right direction. They have decided to try an experiment on the largest scale with the Val de Travers asphalte in the greatest carriage thoroughfare in the world—Cheapside and the Poultry. If it answers, the street-paving of every great city in England will be revolutionized, and the street-cleaning too. If it fails, the commissioners will still have done their duty. They came to this decision, involving a very large expenditure, on the report of their engineer, whose opinions, for a responsible official, are very decided on every question except expense of maintenance; that he leaves to experience. An experiment was made in Threadneedle Street, over which about 2500 vehicles pass daily, in May, 1869; therefore rather more than a year's trial has been made on a spot of important traffic. The following extracts give the pith of the report:—

The pavement is called "compressed asphalte," to distinguish it from those asphalte pavements which are made by boiling the material to a liquid state, and it was formed in the following manner:—A foundation was first made of Portland cement concrete, 8 inches thick, on the top of which a coating of mastic, about half an inch in thickness, was run and worked to the proper slopes and curvatures; upon the mastic the asphalte from the Val de Travers, in Switzerland, was laid. The asphalte is entirely composed of the natural rock, ground to a powder, and subjected in that state to great heat in a revolving boiler on the spot; it is then taken out, laid over the surface, and, whilst in its heated state, compressed with heated irons into one homogeneous mass, without joints, and impervious to moisture. The thickness intended to be laid was 2 inches.

The mastic referred to is not ordinarily employed in compressed asphalte pavements, but was used in this instance because the weather was exceedingly wet when the concrete was laid.

On one occasion two holes, each about 15 inches square, were cut through the asphalte. In one case the mastic was cut through; in the other it was untouched. The heating-boilers were on the ground, the holes were filled up with fresh asphalte, and the surface made good. The time occupied in cutting through and remaking the surface of each opening was about a quarter of an hour; in three-quarters of an hour afterwards the traffic was allowed to pass over it; so that the entire operation occupied about an hour. The weather was fine.

On another occasion an opening 18 inches wide was cut across the street from kerb to kerb. The time employed from the cutting out to the completion of the repair and opening to the traffic was about three hours and twenty minutes. A shower of rain occurred whilst the work was in hand, which delayed it.

For the due consideration of the subject, comparison must be made with the road surfaces generally in use in the metropolis, which are pavements formed with 3-inch or 4-inch Aberdeen granite stones, and macadamized roads made with Guernsey granite.

The value of the compressed asphalte pavement may be considered under the following heads:—

1. Convenience and comfort; 2. Safety; 3. Facility of cleansing; 4. Facility of construction and repair; 5. Cost.

Comfort and Convenience.

The surface being smooth, and without joints, the traction of vehicles is much reduced; in fact, the wheels of carriages run almost as easily and as smoothly over it as they would on a street tramway; and, consequently, passengers in carriages are less jolted, and the fatigue of horses is diminished.

It is impervious to moisture; water falling upon it, therefore, runs off, or is evaporated quickly, if the surface is in a good state.

It is nearly, if not quite, as noiseless under the traffic as a wooden pavement. If the streets of the City, and especially the main thoroughfares of large traffic, were laid with it, the comfort to the inhabitants and passengers would of course be very great.

Formation and Repairs.

Pavements of compressed asphalte can be laid new in about the same time as granite pavements; that small surface repairs can be made as expeditiously; repairs not involving the removal of the foundation can be made much more effectively than to stone pavements.

Large repairs are at Paris made neatly, skilfully, and rapidly, but the openings, excepting for mere restoration of surface, are but few as compared with London, and the soil is better for the purpose than it is in this metropolis.

Over deep excavations, it is doubtful whether repairs can be made so quickly, and it may be necessary to fill in the holes with hard material of some sort, and allow the traffic to pass over it until the ground consolidates; this sometimes is done at Paris.

Granite pavements can be repaired more quickly under these conditions, but are frequently taken up and relaid two or three times before the surface is made good permanently; of course the asphalte can be also taken up and replaced if it sinks, but how this will affect the expense I cannot say. It may be remarked that the area to be relaid over a trench will be less than in a granite pavement, on account of the neatness with which the trench can be cut.

Repairs cannot, I think, be made to the asphalte in wet weather, nor over a wet substratum; the repairs to stone pavements can be made during such times, and whether the foundation be wet or dry; but work is then avoided as far as possible, as it is rarely satisfactory.

The asphalte pavement can be laid and repaired during hard frost, provided the weather be dry. Repairs to granite pavements cannot well be made in frosty weather.

Pavements jointed with lime grout are covered afterwards with fine gravel for from one to two weeks, according to the weather, during which time there is mud or dust and public inconvenience; repairs are treated in a similar manner. The dirt is carried some distance by the traffic, and the streets, owing to this, are frequently not so clean as they otherwise would be; some of the sand, also, falls into the gullies and sewers, and has to be removed from them. This is a constant source of complaint by the superintendent of street-cleansing, and a source of expense to the Commission, both in respect of street-cleansing and in cleansing the sewers.

Compressed asphalte pavements are, when laid, fit for the traffic a few hours afterwards, and repaired surface is equally so. All are left perfectly clean, and are, consequently, free from the inconvenience referred to.

Pavements of which the joints are grouted with asphalte, or with compositions asphaltic in character, need not be covered with balast, and are also free from this objection.

Durability.

The question of durability is the question of cost, and on this head there is no experience in England.

At Paris it is more expensive than granite, nevertheless there are already, I believe, more than 15 miles of street laid with it, and it is being extended on account of the advantages it affords, which, in the opinion of the authorities, outweighs the difference of cost.

The company inform me that their price in the City for laying down the new pavement will be from 14s. 3d. to 16s. 3d. per yard superficial (not including the foundation), the new work to be paid for when completed; and that they will undertake for a period of 18 years to maintain it in repair at coats varying from 6d. to 1s. 6d. per square yard per annum, according to the traffic of the street, *and leave it at the expiration of the term in as good a condition as new;* openings for gas, water, sewerage, and other purposes will, of course, be paid for extra. If these be their lowest prices, it will be more expensive than granite pavement in London.

It has been found in Paris cheaper than macadamized roads, but they have not there such good material for forming the road surface as there is in London. It is probable, however, that where there are macadamized roads in streets of considerable traffic in London it will be found quite as cheap, and with proper management will give the convenience without the disadvantages of macadam.

Wet weather does not deteriorate the asphalte, nor do pools of mud form upon its surface, and deteriorate the surface as in macadamized roads, but it has no superiority over granite pavements in this respect.

My general conclusions with respect to the Val de Travers compressed asphalte carriage-way pavements are, therefore—

1. That they will afford much convenience and comfort to the inhabitants and traffic.

2. That, with surface cleanliness and reasonable care in times of frost, they may at all times be made safe for the traffic in streets of ordinary gradient.

3. That they afford opportunity for increased cleanliness in the streets, and perhaps at diminished cost.

4. That they will be more expensive than granite pavements, but not more expensive than macadamized roads of considerable traffic, but that the relative expenses cannot yet be determined.

5. That it is desirable to try the pavement on a much greater length of street, and under various conditions of traffic.

As to "*safety*," if a street were kept perfectly clean it would not be more slippery than granite or macadam; but it is not safe or suitable for "streets with sharp gradients like Ludgate Hill," where, too, it would be destroyed by the skids. "*Cleansing*" asphalte pavement being without joints, may be performed more economically than on granite or macadam. It may also be frequently cleaned by simply washing.

The report of the Commissioners of Inland Revenue, which is a condensation of thirteen reports issued since 1857, bringing down the subject to the end of the last year, is a document of considerable interest at the present moment. For twenty-two years, with the exception of the short sharp interval of the Crimean War, we have been accustomed to a periodical reduction of taxation to an amount which it is difficult for the rising generation to appreciate. As we now feel unpleasantly certain that the negotiation for giving up Belgium to the French (with Antwerp a perpetual threat to England) was only broken off because France declined to sanction the conquest or absorption of Holland—for that is the true reading of the draft treaty with the report of the interview of the favoured correspondent of the *Daily Telegraph* with the French Emperor—war with war taxes loom in the distance. This Blue-Book shows what we have borne, if not what we are able to bear. Before 1857, but within the recollection of statesmen in the Cabinet, Excise taxes, with all their annoying restrictions and artificial crimes, had been removed from salt, soap, candles, leather, and glass. We know an old lady who remembers keenly, in Pitt's time, the consternation that fell upon a rural Scotch household when warned by the exciseman that it was no longer lawful to manufacture candles and soap from the fat of the beast killed and salted for winter consumption. The commissioned officers of the Excise are nominated by the Lords of the Treasury, and must pass an examination by the Civil Service Commissioners in the first instance. They are then open to gradual promotion. The salary commences at £60 a year, with an allowance of 2s. a day for expenses when on duty, and a very gradual rise; the outside prize being £800 a year; the average probability £300, after a life's service. How honest men are got for the money is amazing. Considering the low salaries and the large temptations, absolute and stoical integrity in the lower departments, where existing, is almost miraculous. The total Excise duties collected in 1869 from spirits, hackney carriages, railways, licences, and minor sources amounted to £20,450,000, being £270,000

above 1868. Of this total, licences produced over £2,600,000; malt, £6,500,000; and spirits over £10,500,000—a sufficient reason why every Chancellor of the Exchequer, of any politics, will hesitate to meddle with the duties derived from drink. Beer cannot be touched without interfering with spirits. The war taxes on spirits were 11s. 8¼d. per gallon in England, 6s. 2d. in Scotland, and 5s. 7d. in Ireland. These two last, in consequence of the enormous extent of illicit distillation in those countries, were reduced in 1823 to 2s. 4¾d. in both, and in 1825 the English duty was reduced to 7s. per gallon. Since that date, by successive steps, the duties in England, Scotland, and Ireland have been equalized, and raised to 8s. per gallon. Illicit distillation has been virtually put down in England and Scotland, and only feebly exists in Ireland. Immense improvements, in detail arrangements, accompanied this increase. The final result has been a larger revenue by over £3,500,000 sterling, with a diminished consumption of spirits, and an increased consumption of beer, tea, and cocoa. The consumption of British spirits has decreased 32 per cent.; of foreign and colonial spirits, 56 per cent. The increase of consumption of foreign wine has been 116 per cent.; of beer, 32 per cent.; tea, 77 per cent.; and cocoa, 55 per cent. So also England, since the duties on spirits were raised in 1852, has increased its consumption of beer by more than 11 per cent., Scotland by 60 per cent., and Ireland by 122 per cent. The repeal of the duty on methylated spirits, mixed with wood naphtha, destroyed the trade of illicit distillation in London. Indeed, the whole report shows an intelligence—a willingness to learn and to improve which does great credit to the Board of Inland Revenue. A duty on malt has been levied in England since the year 1697. The duty, 2s. 7¼d. per bushel, is collected without much fraud or evasion. Of the whole revenue in 1869, £212,000 was paid on sugar used in brewing. Foreign malt is subject to a duty of 25s. per quarter of 8 bushels. The export of beer subject to drawback is large and increasing. The paper duty was repealed in 1861. Between 1842 and 1855 the quantity of paper made was nearly doubled. The revenue given up exceeded one million sterling. The condensed report contains all the reasons for *not* repealing the duty contained in the report of 1857-8. About £30,000 a year was saved by the repeal in salaries and expenses of the paper excise. Penny and halfpenny papers were made possible, and entirely new raw material brought into use for the manufacture.

The number of miles travelled by road carriages appears to have increased with each reduction of duty between 1863 and 1867. The commissioners query whether this increase is not partly due to the more honest returns made under a low than under a high duty, "as in the case of the income-tax." The increase was steady, from 31,500,000 miles in 1863 to over 34,000,000 miles in 1867. The enormous inequality between the taxes on railways and on stage carriages made the claim for repeal very strong. "The London General Omnibus Company have furnished reliable data for the inquiry." In 1864 the gross receipts of the General Omnibus Company were £612,400. The duty paid by them was £53,000, or 8·7 per cent. of their earnings. In the same year the railways in Great Britain earned nearly £32,500,000, and paid less than £500,000 duty, or 1·3 per cent. on their earnings. At the same rate as the Omnibus Company, they would have paid over £2,800,000. The duty of the General Omnibus Company absorbed 44 per cent. of their profits.; the duty on railway companies, 2·4 per cent. of their profits. The results to the public remain to be seen, but are certain. In 1815, 1200 licences were issued to hackney coaches, chariots, and chairs in the metropolis; in 1869, 5600 were issued. We trace the attempt of the Chancellor of the Exchequer to alter the incidence of the railway duty to the commissioners report. It was, it will be remembered, a failure. Brewers licences were first imposed by Mr. Pitt. In 1830, 36,000 licences were issued; the number increased until 1838, when there were nearly 50,000. Since that date the trade has steadily declined, the big brewers devouring the little ones as the manufacture became more of a science, and the facilities of conveyance increased. The change from an assessed tax to a dog licence was a financial revolution; 400,000 more dogs were licensed in 1867 than were assessed in 1866! This practically sealed the fate of non-official tax-gatherers. The house duty was first imposed in 1696, was repealed in 1834, and reimposed in 1854, when the window-tax was repealed. The relief thus offered to the tax-payer was equal to about a million sterling. Without any increase in the duty, the produce has increase from £700,000 to over £1,000,000. Here, for the present, we close our extracts from a Blue-Book, more useful and more amusing than many pretentious historical volumes.

The Royal Agricultural Society at Oxford presented to the examination of the inhabitants of that ancient and learned city a magnificent collection of machinery, which had nearly all been invented and made in reply to agricultural demands since the same society held its first show there in 1839. It will be well if the Corporation of Oxford, which claims to be liberal and enlightened, will take a lesson from the farmers, and put some of its most important and neglected duties on a level with the demands of the times. It is not long since a fire occurred in Oxford, by which, besides property, two lives were sacrificed—a little more wind might have put one of the most splendid libraries in the world in a blaze. On that occasion it became known that the Corporation possessed no fire-engine, and managed its water-works so badly that no water was to be had until the fire had gone too far to be checked. As it took twenty minutes to send a message to the turncock at the water-works, and forty minutes to get up the steam of the borrowed engine, the attempt at fire-suppression turned out a farce. The secret of a transaction so disgraceful to the municipal intelligence of Oxford lies in all the administrative power being vested in one once able man, now reduced, if not to mental impotence, to utter incompetence, by old age. The chairman of the Corporation Water-Works and Gas-Works Committee is nearly eighty years of age, stone blind, and yet still retains the influence of his past services. His colleagues do not like to turn him out, and he will not resign, even for a pension, the salary of £300 a year attached to his office, and the patronage. He has refused a pension, and waits calmly until the Bodleian Library is burned down, and some frightful accident with the Corporation's very impure gas compels powers outside the Corporation to interfere. One nuisance has been created by the Oxford Gas-Works which must shortly attract the attention of the Home Office. For fifty years all the ammoniacal refuse has been discharged into the soil, and has filtered away through the porous earth until all the neighbourhood has been polluted, and it is only wonderful it has not reached the gathering-grounds of the water-works. What are the Oxford Dons of the new school about? Surely they might extend some share of their reforming zeal to local affairs. Government officials are not the only persons who suffer from the red-tape disease of servility.

Circular to Gas Companies.

The Gas and Water Facilities Bill has now arrived at such a stage that it may be deemed as law, and we have to consider what its effect will be on gas and water legislation. In the first place, the system of private Bill legislation, as regards these matters, will be almost entirely swept away. It is true that there is nothing to prevent an application for a private Bill, but it is highly improbable that any company will promote such a Bill when there is a way open to them to obtain parliamentary sanction which promises to be both easier and cheaper. Originally suggested to afford non-statutory companies facilities for obtaining statutory powers, the Bill has been extended to meet every case in which parliamentary powers are required for gas and water undertakings. Briefly stated, the object of the Bill is to simplify the proceedings necessary for obtaining the sanction of Parliament—1, for entirely new undertakings; 2, for undertakings already established; 3, for enabling these latter to raise additional capital; and, 4, to facilitate the amalgamation of two or more undertakings. The Bill may also, perhaps, be accurately described as one "to facilitate "the establishment of undertakings in districts within which "there is not an existing company, Corporation, body of commis-"sioners, or person empowered by Act of Parliament." Clause 4 makes a large promise. "Provisional orders," it says, "authoriz-"ing any gas undertaking or water undertaking under this Act "may be obtained in any district by any company or person;" and that the promotion of rival undertakings is anticipated is shown by clause 5, which requires notice to be given by the undertakers intending to apply for a provisional order to every company, Corporation, or person supplying gas or water, as the case may be, within the district to which the proposed application may refer. It is true that the consent of the local authority is to some extent necessary before a provisional order can be obtained. But seeing how often a non-statutory company is at variance with the local authority, this saving clause will afford but little protection to established interests, while the proviso that the consent of the authority may, under some circumstances, be dispensed with is by no means reassuring to a company with a favourable majority upon a local board, but with busy opponents outside it. On the whole, we cannot help thinking that the Bill is fraught with some peril to many of those for whose special behoof it was intended, since there can be little doubt that it will give rise to the promotion of a considerable number of rival schemes. We are as yet in ignorance of the machinery by means of which the Board of Trade, or any other department of State, will discharge the onerous and important duty thrown upon it by this Act.

There are now above a thousand gas and water companies

in the kingdom not in the enjoyment of parliamentary powers. Of this number no doubt a considerable proportion will make the earliest possible application for provisional orders. Many of these it is certain will be opposed by local authorities or by rival undertakings. How will the department of State charged with the duty hear and adjudicate upon these cases? The avowed object of the Bill is to simplify and cheapen the process for obtaining parliamentary powers; but we should not be surprised if, in the result, the costs (except in small and unopposed undertakings) were found to be as heavy as under the old system.

The fourth report of the commission appointed to inquire into the condition of the Exchequer standards, which has just been issued, gives the opinion of the commissioners on the Sale of Gas Acts and the inspection of meters; and as the matter is of the highest importance to gas companies, we print that part of the report *in extenso* in another place. It will be seen that the commissioners express the strongest dissatisfaction with the present state of affairs. The Sale of Gas Act has practically received but a limited application, and its provisions are to some extent interfered with by local Acts obtained by various gas companies. Since the consumption of gas is largely extended every year, the commissioners think that the objections made to the Act of 1859 by the North Riding magistrates, which led to its adoption being made optional in counties, are no longer tenable, and they hold that it is expedient to establish a general and uniform system of inspection of gas-meters, such as is now established in the metropolitan district. It is recommended, therefore, that the Sale of Gas Acts shall be repealed, and the provisions re-enacted in a general Act consolidating the laws relating to weights and measures, but with some modifications. The adoption of the provisions relating to the inspection and verification of meters in counties the commissioners propose to still leave optional; the resolution not to adopt them must, however, be carried by a majority of not less than two-thirds of the magistrates present. The duties of the inspector of meters in counties are to be exercised by the verifier of weights and measures, who is to be provided with the requisite standards and appliances. All gas-measuring standards, to be legal, shall be reverified by the Standards Department within a period of ten years. Gas-meters, too, to be legal, will also have to be reverified and restamped within a period of ten years. Gas-meter makers are to be licensed and registered, and each must have a distinctive stamp. All meters are to be marked with the number of lights they are constructed to supply, each light being computed to consume 5 feet per hour, at a pressure of 0·5 of an inch of water. The commissioners consider that the great defect of the existing system of the verification and inspection of weights and measures and of gas-meters—and, so far as the latter are considered, we are bound to admit that it is a great defect—is the want of an efficient central control. Without such control we agree with them in thinking that there can be no adequate security for the proper discharge of the duties imposed upon local authorities and officers. This defect, it is thought, may be remedied by placing the whole arrangements under the supervision of the Board of Trade, who should appoint two or more inspectors of standards to travel about the country with official standards for the purpose of verifying local standards and apparatus, and ascertaining that the office accommodation and arrangements of the local inspectors are complete and effective. The powers it is proposed to give to the Board of Trade and these official inspectors are large, but not too large, perhaps, to meet the full requirements of the case. If it be considered requisite to have any inspection at all, it is best that it should be authoritative and effective. It is not likely that meter-makers will have any objection to be licensed and registered; and it is only proposed to interfere with gas companies so far as to prevent the provisions of the general law from being defeated by clauses subsequently introduced into local Acts.

The Sheerness Local Board have not yet got over their difficulties with the public clock, and have not yet made up their minds on the gas question. At the last meeting of the Board some ratepayers adopted the sensible course of protesting against the expenditure of public money on plans for gas-works, and expressed their intention to hold the members of the Board individually and collectively responsible for the amount so expended. This was the proper course to take under the circumstances. We must wait until the next meeting to learn what effect the protest will have on the determination of the Board, but it is to be hoped that it will induce them to retrace some of the steps they have taken, and to listen with reason to the fair proposals of the gas company. The protest, which may now or at a future time be of interest to some of our readers, we here subjoin:—

To the Local Board of Health in and for the District of Sheerness, in the Parish of Minster, in the Isle of Sheppy, in the County of Kent.

We, the undersigned, being respectively householders and ratepayers, rated to the relief of the poor, and liable to the payment of all rates legally made, assessed, and levied in the said district, do hereby give you notice that we protest against and object to, as illegal, the payment by you, or by any other person authorized or assumed to be authorized by you, of any moneys, or the incurring by you, or any person authorized or assumed to be authorized by you, of any costs or charges in respect of the making or preparing of plans, specifications, and estimates for the erection of gas-works, so far as such payments shall be made out of, or such costs and charges shall be charged upon, the proceeds now in your hands, or hereafter to be received by you, or by any person authorized or assumed to be authorized by you or on your behalf, of any rates, tolls, charges, or assessments, of what nature or kind soever, made, assessed, and levied, or to be made, assessed, and levied, in the said district, or upon any of your funds or property of any nature or kind soever, or upon any public moneys which shall have come or may come into your hands, or over which you exercise or may hereafter exercise any control.

And we hereby give you further notice, that in case any moneys shall be expended, or any costs and charges shall be incurred, directly or indirectly, in respect of the making and preparing of such plans, specifications, and estimates for the erection of gas-works, we intend to take all legal proceedings as we may be advised, and as may be necessary, against you, the said Local Board of Health, in your corporate capacity, and against each and every or any of you the members of the said Local Board, individually or collectively, for the purpose of holding you liable for the payments illegally made, and for the purpose of quashing any order for the payment of any such costs and charges as above mentioned from out of the proceeds of any rates, tolls, charges, and assessments, or from or out of any public moneys which shall have come or may come into your hands, or over which you exercise or may hereafter exercise any control, and to enforce the payment and replacement of any sums which may have been so appropriated or expended.

As witness our hands, this twenty-first day of July, one thousand eight hundred and seventy.

JOHN VENNING, Sen.
JAMES SAMSON.
W. J. HISCOCK.
W. E. MUNN.
ISAAC D. BLACKMAN.

A case of considerable importance to some of the metropolitan gas companies has been heard at the Southwark Police Court. The Surrey Gas Consumers Company were summoned by a publican named Tallentire for refusing to supply him with gas without security. The company relied upon the 14th section of the Metropolis Gas Act of 1860; but the magistrate, Mr. Benson, decided that under that clause a gas company could only claim security in respect of premises not previously supplied with gas. This decision of the worthy magistrate is directly at variance with decisions given at the same court by some of his predecessors, and, whatever may be the strict reading of the letter of the Act of 1860, is obviously at variance with its spirit, and the whole tenor of subsequent legislation on the subject. In all the Acts obtained by metropolitan companies since 1860, it is provided that security may be required from a tenant entering on the occupation of premises already supplied with gas, who proposes to continue the use of such gas. The point is of so much importance that it is to be regretted the Surrey Consumers Company did not adopt the suggestion of Mr. Benson, and obtain an authoritative decision from the Court of Queen's Bench; for, if the decision of the worthy magistrate were upheld, it would be to the interests of the companies who are still under the Act of 1860 to join in promoting some general enactment which would remedy this obvious injustice. It cannot be alleged that the London companies have ever harshly used their right to demand security; and it is only fair to give them the privilege which every tradesman possesses—to refuse credit to customers of doubtful reputation.

We hear with regret of the death of Mr. Esson, of Cheltenham, on the 25th ult., after a long illness, which, it will be remembered, prevented him from fulfilling his duties as president at the late meeting of the British Association of Gas Managers. As a practical gas manager Mr. Esson stood high among his brethren, by whom his loss will be much regretted.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, JULY 18, 1870.

THE ST. HELEN'S GAS BILL.—The Commons amendments were considered, and agreed to.

THURSDAY, JULY 21.

THE OLDHAM CORPORATION WATER, &c., Bill was returned from the Commons, with the amendments agreed to.

FRIDAY, JULY 22.

GAS AND WATER FACILITIES BILL.

The report of amendments having been received,

Lord REDESDALE said: My lords, in clause 3, line 13, I propose to leave out the words "duly authorized to supply," for the purpose of inserting "supplying." The whole principle of the bill is to enable persons at a small expense to do that legally which in many cases is done without legal authority, by permission of highway and other boards, in the way of breaking up roads in order to lay down gas and water pipes. If the words "duly authorized," which can only be by Act of Parliament, are retained, all those cases will be excluded from the operation of the bill, but the amendments will enable all such companies or persons to amalgamate, and so to make a good concern, which would be able to supply the district better.

The Earl of KIMBERLEY: I entirely agree with the noble lord as to the object of this bill, but I cannot help thinking that it would be better to confine it to companies duly authorized, and I cannot consent to the noble lord's amendment.

Lord REDESDALE: What is now proposed is that the companies are first to get authority, and then they may be amalgamated. What I propose would save a great deal of expense. I hope, therefore, that the noble earl will consider the matter before the third reading.

The Earl of KIMBERLEY: I shall be happy to do so.

The amendment, therefore, was not pressed.

Lord REDESDALE: The next amendment is one to which I hope the noble lord will not object. The great end I have in view is the public interest—the cheap service of gas and water. When parties come before Parliament for the purpose

of extending their works, and of raising additional capital for the purpose, there is always a restriction inserted upon the amount of interest to be paid upon that capital. It seems to me to be only fair that that should be done in the present bill.

The Earl of KIMBERLEY: I think that that is a matter on which it is safer to leave the companies to the ordinary law, and I am therefore sorry to say that I cannot consent to the noble lord's proposal.

Lord REDESDALE: Then the public will be less protected under this bill than they are now under the existing law. The only other amendment which I have to propose is in clause 9. After the word "publication," I would propose to insert "not later in any year than the 1st of April, or if Parliament be not then sitting, on its first day of sitting after that date." Everything that has occurred has impressed upon my mind the importance of having a limitation of time, and I hope, therefore, that the noble lord will not object to the insertion of the words which I now propose. The reason I take the 1st of April is, that we took the 1st of May for the tramways, and I think it is desirable that all these bills shall not come before Parliament at the same time.

The Duke of RICHMOND: I quite agree that it would be very advisable, and a great advantage, were these bills brought before Parliament as early as possible in the session. Still I think the matter is one upon which we cannot lay down any rule which can never be departed from, as would be the case if the proposal were inserted in the bill. On the other hand, a Standing Order may be dispensed with if circumstances should render that desirable, and I would, therefore, recommend that that course should be adopted.

The Earl of KIMBERLEY: I think the advice of the noble duke is very sound. If there is any limitation placed upon the time during which application must be made, parties who desired to go before the Board of Trade might find their case prejudged.

Lord REDESDALE: Bills to be brought before Parliament must be deposited on the 1st of December, and from the 1st of December to the 1st of April would be sufficient time for considering the not very numerous applications that would be made under the bill. I confess I think that some limitation would be very desirable, and unless it was placed in the bill there would practically be no limitation at all. There is a bill now before your lordships which was read a first time last night, and which was only brought into the other House on the 11th of July—I refer to the Piers and Harbours Bill—whereas our order fixes the last day for the second reading of such bills on the 21st of June. Now, my lords, I think that that is absolutely insulting to this house, and the only way in which such a system of evading our orders can be prevented is to place the limitation in the bill. For the protection of the public, we ought to take care that sufficient time is allowed to petition against bills.

The Earl of KIMBERLEY: The noble lord has terrified me so much, that if he is disposed to adopt the 1st of May I will accept that date.

Lord REDESDALE: I will agree to the 1st of May.

The noble lord's amendment, with this modification, was then adopted; and on the following Monday the bill, with some amendments, the nature of which was not explained, was read a third time and passed.

MONDAY, JULY 25.

The GAS AND WATER FACILITIES Bill was read a third time, with the amendments, further amendments made, the Bill passed, and sent to the Commons.

TUESDAY, JULY 26.

The BLACKBURN CORPORATION IMPROVEMENT Bill was read a third time, with the amendments, further amendments made, the Bill passed, and sent to the Commons.

HOUSE OF COMMONS.

TUESDAY, JULY 19, 1870.

The OLDHAM CORPORATION WATER, &c., Bill.—The Lords amendments were agreed to.

Legal Intelligence.

SOUTHWARK POLICE COURT.

TUESDAY, JULY 19.

(*Before* R. A. BENSON, *Esq.*)

Mr. *W. P. Boddy*, the secretary of the Surrey Consumers Gas Company, attended to answer a summons taken out by William Tallentire, the keeper of a beershop in St. Thomas's Street, Southwark, under the 16th section of the Metropolis Gas Act, 1860, which provides that, if the owner or occupier of premises in which a supply of gas is required and the gas company cannot agree as to the nature and amount of the security to be given by the former for the payment of the gas-rate and meter-rent, such security shall be determined by a magistrate.

Mr. EDWARDS, solicitor, appeared for the plaintiff; and Mr. EDWIN, solicitor, for the defendant.

The summons came on for hearing on the 14th inst., when it was stated that the plaintiff had tendered £5 as security, but the defendants required a deposit of £10, and had declined to furnish him with a supply of gas until that amount was handed over to them.

Mr. BENSON, upon reading the clauses 14 to 17 of the Metropolis Gas Act, expressed an opinion that this was a case in which he had no jurisdiction, inasmuch as, upon his reading of the Statute, the gas company could only demand security in respect of premises not previously supplied with gas; he, however, adjourned the summons to this day for further consideration.

Mr. EDWIN said since the adjournment, in consequence of what fell from the bench, he had carefully looked through the Act, and he believed the view taken by the magistrate was correct—that he had no jurisdiction.

Mr. BENSON said he did not at all underrate the importance of the question raised by the summons; it was, in fact, a most important matter for both the buyer and seller of gas. He was very much startled to find that the view he had expressed upon the construction of the Act of Parliament was directly opposed to the opinion acted upon by his predecessors in that court. He was bound, however, to say that his opinion had been fortified by reflection. He had not the shadow of a doubt that the gas company were not entitled to have any security at all in such a case as the present.

Mr. EDWIN said he thought the magistrate was perfectly right, and that all he could do now was to dismiss the summons.

Mr. BENSON remarked that it was very satisfactory to him to have his opinion thus confirmed. He was prepared to state a case for the opinion of the Court of Queen's Bench, if the company thought he was incorrect in his interpretation.

Mr. EDWIN said he did not wish it upon the present summons, but the company would come forward on a future occasion and fight the point to the death.

Mr. BENSON asked how they could do so if they now retired.

Mr. EDWIN said it would be under a different section altogether. At the present time, after what his worship had stated, and looking at the Act of Parliament for himself, he did not think the bench had power to deal with the case. The company had been making some inquiries respecting the plaintiff, and, if he liked to make proper arrangements with them, they would supply him with gas.

Mr. BENSON: But he asks me to see that he is supplied with gas now. The company must give him a supply.

Mr. EDWIN: You have the summons before you, sir, and under the Act of Parliament all you can do is to dismiss it. If the plaintiff likes to take out a fresh summons under a different section, we shall fight the case out on its merits.

Mr. BENSON: Very well. How is the summons worded? (The summons was handed in, and it appeared that the company were called upon by it to appear before the magistrate and take his decision, inasmuch as the plaintiff, "being desirous to be supplied by you with gas at his house in the parish of St. Thomas, in the county of Surrey, and within the said district, and having offered to deposit with you the sum of £5, you are unable to agree with him as to the amount to be deposited by him with you in respect to such supply of gas.") As you are on a matter of formality, I am inclined to doubt whether there should have been a summons at all. The words of the Statute are that the magistrate "shall, on the application of the owner or occupier and the gas company, or either of them, determine the nature and amount of the security to be given." I do not think under that section there should have been a summons.

Mr. EDWIN: I am not in the habit of picking holes in summonses.

Mr. BENSON: No; but when you say "dismiss the summons"—the summons being irregular—I do not know whether that would be the right course to adopt. Both parties come before me on equal grounds; they ask me to decide between them, and my decision is that the company are not entitled to take security.

Mr. EDWIN: No doubt there was no necessity for a summons.

Mr. BENSON: I decide that no security is required in this case.

Plaintiff: Now can I have the gas laid on?

Mr. BENSON: You must take what course you think right. Have you required the company to lay on the gas?

Plaintiff: I have.

Mr. BENSON: In writing?

Plaintiff: Yes.

Mr. BENSON: And they have not done it?

Plaintiff: No.

Mr. BENSON: Then you may have a summons to compel them.

SATURDAY, JULY 23.

Mr. *Boddy* appeared this day to answer the second summons taken out against him as secretary of the Surrey Consumers Gas Company, at the instance of the above-named plaintiff, which summons charged that "you did wilfully fail for seven days after being thereunto required in writing, to wit, on the 8th day of July, 1870, by the said William Tallentire, to furnish a supply of gas, or to furnish any meter, pursuant to the provisions of the Metropolis Gas Act, 1860, to the premises of the said William Tallentire, known as the Brighton Tavern, St Thomas's Street, Bermondsey, in the country of Surrey, within the said district."

Mr. LILLEY, barrister, instructed by Mr. Edwin, appeared for the company, and Mr. EDWARDS for the plaintiff.

Mr. EDWARDS said the plaintiff was the keeper of a public-house or beershop, which had been, during its occupance by a former tenant, supplied by the Surrey Consumers Gas Company with gas. The company refused to furnish a supply to the plaintiff until he had given them security, which security the magistrate decided on the last occasion they were not entitled to claim. The present summons was taken out under the 17th section of the Act, which provided that "If the gas company, not being entitled to require or not having required any security, wilfully fail for seven days after being thereunto required in writing by the consumer, or where the security agreed on or determined by the magistrate is given, shall wilfully fail for fourteen days thereafter to provide and lay all proper and sufficient communication, service, and other pipes, or to furnish a supply of gas, or to furnish any meter, pursuant to the provisions of this Act, then and in every such case the gas company shall, on a summary conviction before a magistrate, forfeit and pay to the consumer not exceeding forty shillings for every day after the expiration of seven or fourteen days respectively during which the failure continues." He did not know what course the learned counsel who appeared for the company intended to take, but if, as he understood, the simple intention was to lay the foundation of a case for the opinion of a superior court, possibly the case would be much shortened by his making a statement which both parties could agree upon.

Mr. BENSON: You had better formally prove your case as though we knew nothing about it.

Mr. EDWARDS: As your worship, however, has heard the case before, I will save time by not making any further observations, but will at once call Mr. Boddy.

Mr. BENSON: You had better call the plaintiff first.

Mr. EDWARDS: No, sir; I think I should first prove that the premises are within the company's district.

Mr. *W. P. Boddy*, examined by Mr. EDWARDS.

I am the secretary of the Surrey Consumers Gas Company, which is one of the companies coming under the provisions of the Metropolis Gas Act, 1860. I do not know the defendant's house, the Brighton Tavern, St. Thomas's Street, but I know that it is within our district. On the 7th inst. I received a communication in writing from the complainant, to which the letter now produced with my signature is the reply.

Mr. BENSON: Mr. Martin (the clerk) reminds me that, considering this is to some extent a criminal information, it is rather irregular to examine the defendant, and there is not the least necessity for it.

Mr. EDWARDS: I was endeavouring to find out whether he is the defendant at all. I do not know whether this is one of the companies which can be sued as a company.

Mr. BENSON: I do not see what you want to call the secretary for at all. Your own client can prove the district. He can prove the receipt of the company's reply, in which they do not deny it. I cannot anticipate the defence, but it certainly is irregular to examine the defendant. This is an action against him for penalties.

Mr. LILLEY: If there is a conviction there will be a penalty, and therefore I shall ask you, sir, to begin the case *de novo*, and let the complainant prove his own case.

Mr. BENSON: Can you show me, Mr. Edwards, that this is a company which can be proceeded against through the secretary?

Mr. EDWARDS: No, I cannot; for I do not know whether they have a special Act. I did not take the summons out against the secretary, but against the company.

Mr. BENSON: You do not know whether there is any private Act belonging to the company?

Mr. EDWARDS: No, I do not; though, singularly enough, I happened to be engaged in the promotion of the company.

Mr. LILLEY: The learned gentleman seems to look to me to fill an abnormal office, and assist him to prove his case. I am here for a contrary purpose, and, though I do not offer any vexatious opposition, I must see that he proves his own case.

Mr. BENSON: I should like to see whether the secretary is the proper person. From the wording of the Act of Parliament I should say the company, as a company, should have been summoned. You had better prove your case from your own client.

William Cape Tallentire, examined by Mr. EDWARDS.

I am the keeper of a beer-house—the Brighton Tavern, in St. Thomas's Street. I have been the proprietor for a fortnight. I took possession on the 7th inst., having purchased it from a former tenant. When I took it, it was a shut-up house. I had known it previously, and it was then supplied with gas. On the 7th of July I caused the following letter to be sent to the company:—

Brighton Tavern, St. Thomas's Street, July 7, 1870.

Gentlemen,—I hereby give you notice that I intend opening the above premises to-morrow (Saturday), the 8th, and unless you comply with my request in supplying me with gas to enable me to carry out my business, I shall, without further notice, hold you responsible for all losses I may sustain. I do not want for any credit. Unless I hear from you by ten to-morrow (Saturday) I shall appeal to the sitting magistrate.—Yours, &c., (Signed) W. Tallentire.

I had been to the company before I wrote that letter. The next day I received this reply from the gas company:—

Surrey Consumers Gas Company, July 8, 1870.

Sir,—In answer to your application to have the gas laid on to your house in St. Thomas's Street, the company will be prepared to comply with your request upon your depositing with them the sum of £10 as security for the payment of the rent for the gas to be supplied, and, upon your forwarding the above-named amount to this office, the necessary communications will be made.—Yours, &c., (Signed) W. P. Boddy, Secretary.

After that I saw the secretary on the subject.

Mr. Edwards: And you summoned the company.

Mr. Benson: It was not a summons. It was an invitation to the company to appear before the magistrate. The word "summons" is not applicable. The parties are to apply to a magistrate.

Examination continued: I applied to a magistrate, who decided that no security was necessary. I have applied to the company since then to supply me with gas, but up to two o'clock this afternoon they had not given me a supply. There is no meter in my house. There is a service-pipe in the cellar.

Mr. Edwards: Just tell me what is necessary to be done to enable the company to give you a supply of gas.

Mr. Lilley: I do not think it is at all necessary to go into this. I am not desirous of offering any technical objection.

Mr. Benson: The case is now *primâ facie* made out.

Mr. Lilley: With this exception, that it is not decided whether the company or the secretary should be sued.

Mr. Benson: You had better reserve that point for the present. I believe, as a matter of fact, the plaintiff did summon the company, but in the office it was thought better to sue the secretary.

Plaintiff cross-examined by Mr. Lilley: My name is William Cape Tallentire. I had a house of my own previous to taking the premises in question. I did not leave that house without paying the rent. The landlord did not accept the key, glad to get that because he could get nothing else. I was in treaty with a party for the house, and had been in it for a week or two. I went into the country, and finding that the landlord would not do what he ought to do I sent the keys to him. I did not at that time go in the name of Cape. I do not know that I had done so before. I have traded in the name of Cape. I do not know for how long; perhaps three or four months. I occupied a house—a separate and distinct dwelling-house—and paid rent for it. I had a house of my own for eleven years, in Park Street, Barnsbury. I cannot tell how long it was ago, nor the circumstances under which I left. I passed at that time by the name of Tallentire, not Cape. I have occupied the Brighton Tavern a fortnight. My landlord's name is Gavin. He resides in Waterloo Place, Strand, and is connected with the Queen Building Society.

Mr. Benson: Do not say things at random. Do you know where the man lives?

Plaintiff: It is the Queen Building Society, and his name is Gavin. He has a lease of this house from the Brighton Railway Company. He is the agent of the building society.

By Mr. Lilley: I expect to get a licence for the house myself. There is one at present in the hands of the brewers, and I have applied to have it transferred.

Mr. Lilley: There has been no special petty session for the purpose since you have been in the house. To whom have you applied?

Plaintiff: I cannot tell the person's name. I sent a gentleman.

Mr. Benson: Sent him where?

Plaintiff: To the party, to have the licence transferred from Johnson to me. It was somewhere in Newington.

Mr. Benson: You say you are the occupier of the house, and I must take it that you are.

Mr. Lilley: I am not in a position to show that he is not the tenant, but I am here to say that he is not a person whom, as a commercial matter, a tradesman would trust. I do not desire to cast any aspersion upon him, but I say that, in a commercial sense, he is not a responsible person.

Mr. Benson: Are you prepared to argue before me that he is not a reliable person?

Mr. Lilley: Yes.

Plaintiff re-examined by Mr. Edwards: Mr. Gavin is the lessee of the house. He let the house to Mr. Johnson, from whom I took it, and purchased the goodwill, for which I paid a consideration. I consider Gavin my landlord. The case of my leaving a house which has been referred to is this: I took the house a fortnight before the quarter-day, and paid a week's rent. I was then accepted as tenant. There was no water laid on, and I applied several times——

Mr. Benson: You had some disagreement, I suppose?

Witness: Yes.

Mr. Edwards: Is there any ground for saying you left the house without paying?

Witness: None whatever. The house in Park Street was my own; it had been left to me by will, and was four years in my possession. There was nothing affecting my character in connexion with it. There is no pretence for saying that I left a house without paying my rent. I am in a position to pay for whatever gas I take. As I said before, I do not want credit. I have offered to deposit money with the gas company. That offer was not in writing, but by word of mouth. I offered to pay for the gas either weekly or monthly. I have not the licence with me; it is at the brewers. It is a licence for beer, not spirits.

Mr. Lilley: You need not go into this.

Mr. Benson: I say as plainly as I possibly can, though I do not know what the company's defence is, that I think I shall have no difficulty in deciding the case.

Mr. Lilley addressed the bench for the defence. He said the application made by the plaintiff rested, in the first place, according to the view of the magistrate, upon the 14th section of the Act, and that section presented two different conditions of things—the one relating to the laying down of pipes by the gas company in any new street, and the other to the supply of gas to the owner or occupier of premises, through the pipes so laid down. He concluded, from the judgment expressed by the magistrate on the former occasion, that, in his opinion, this clause and the succeeding clauses to the 17th were to be taken as having a continuing reference to the same subject matter. He (Mr. Lilley) did not deny that there was a continuing reference, but he submitted that in the 14th section there were, as he had already stated, two obligations which were independent of each other—viz., the laying down of pipes and the furnishing of a supply of gas. He also contended that the 15th section was wholly independent of the 14th, though it related to the same subject matter, and that it also contempleted two distinct obligations, the one referring to the laying of pipes, the other to the supply of gas, the pipes being already laid. Whether it was a new or an old street this section applied, and though it must be admitted that the section was inartificially drawn, the intention of the Legislature appeared to be distinct. The word "provided" at the commencement of the clause might for a moment throw a shadow of doubt upon the subject, but it would be found that the following clause commenced in a similar manner, though the former part of it was entirely independent of the other portion. Taking the whole of these sections together, he thought it could not be questioned that, whether in an old or a new street, if gas was to be supplied to a new occupier or owner, the company had a right to require security. The reasonble intention and scope of the whole Act justified this interpretation. It was an Act passed not merely for subserving the interests of the public, but also for affording a just protection to the gas companies, and making it worth their while to come under the stringent regulations which at that time the Legistature put upon them. As the result of experience, he had come to the conclusion that they were bound to look upon reasonable probabilities as a fair test of intention in a matter of this kind, and he asked the magistrate, with some degree of confidence, to apply the principle on the present occasion.

Mr. Benson asked whether the question of deposits had come before any of his predecessors?

Mr. Lilley said it had. It had come before Mr. Burcham under similar circumstances, also before Mr. Selfe; and he had the authority of the secretary to say that during the interval of ten years, since the Act was passed, the gas companies of the metropolis had invariably proceeded upon these sections. If the view which the worthy magistrate expressed on the last occasion were correct, he ventured to think that these clauses would operate rather to the injury of the public than otherwise; because, if they related only to new streets, the company might be in some circumstances exonerated from supplying gas in them at all. Moreover, such a construction would operate in restraint of trade in general, which was alien to the administration of law and its spirit. It placed the gas companies of the metropolis also in a totally different position to that of other traders, and deprived them of a right which on commercial grounds they ought to possess. Under ordinary circumstances a tradesman required references from a person applying for the first time for a supply of goods, and if these references were not satisfactory he declined to have any dealings with him. The gas companies were placed under obligations to give a supply of gas when called upon, and the provision for a deposit was given to them in place of security or reference, and no disadvantage arose to the consumer therefrom, because he was entitled to be paid interest on his deposit. This was the only way in which the companies could be protected, and he asked the magistrate not to take from them the only security the Act gave them, and which they had been accustomed to receive ever since it became law. Gas companies were exposed to great losses, and in this very house the defendants had made bad debts. He further submitted that if the 14th section referred to new streets, the same construction must also be applied to the 17th, and in that case the summons must be dismissed, because the premises in question were not situate in a new street, nor were they for the first time supplied with gas.

Mr. Benson: I take it that this is a point not settled to your knowledge. You do not know of a case in which it has been raised.

Mr. Lilley: No. The companies have always believed they had the power to claim a deposit, and it has not been disputed.

Mr. Benson: And it has been the custom for ten years?

Mr. Lilley: Yes.

Mr. Benson: It is a startling position in which to find oneself, but I am most strongly of opinion that the company are not entitled to demand any security.

Mr. Lilley: If, after what I have urged, you still maintain that view, I shall ask you to convict the company, so that I may take the opinion of the Court of Quarter Session, and I know that there will then be a most careful and discriminating attention given to the matter, and that an equitable as well as a legal construction will be put upon the Act. The decision would also be given in a comparatively brief space of time; whereas, if the case goes to the Queen's Bench, we shall have to wait a long while, and there will be considerable expense incurred.

Mr. Benson: There is no doubt that the opinion of the judges would be more satisfactory than the opinion of the magistrates at the quarter session, but I cannot refuse your right of appeal, if you prefer to exercise it instead of having a case stated.

Mr. Lilley: I shall ask you to give me time to consult my clients.

Mr. Benson: It is very startling to find myself in opposition to Mr. Bureham, a man so much older than myself.

Mr. Lilley: And with great respect to you, sir, it is a startling construction which the gas company now find placed upon the Act of Parliament, by which they alone are deprived of ordinary commercial security, and are constrained to supply any Jack Straw who chooses to apply to them for gas.

Mr. Benson: I should like to know what you say to the 17th section—"If the gas company, not being entitled to require." According to your construction, there never can be a case in which they are not entitled.

Mr. Lilley: If the 14th section be so clear and indubitable, they never would ask.

Mr. Benson: Your argument is that there can be no case in the world, from the Queen's palace to the beer-house, in which they are not entitled.

Mr. Lilley: In which they have not the right.

Mr. Benson: Then what is the meaning of the words "not being entitled to require"? Are they surplusage?

Mr. Lilley: Not altogether surplusage. They may refer to a variety of contingent circumstances. Suppose they asked for security in an irregular and abnormal way, they would not be entitled to do that. You see, in this clause it is a "consumer." Now, I deny that the present applicant is a consumer. You will find in the interpretation clause that "the word consumer means a person receiving or entitled in accordance with this Act to receive a supply of gas." But the applicant is not a person receiving, and I contend he is not a person entitled to receive a supply, because he has not placed himself in the position which the Act requires. He has not fulfilled the antecedent condition, and therefore he is not a consumer. You will see that in the 17th clause it does not say "owner or occupier," as in the 14th, and I say, though he may be an "owner or occupier," he has never been in the position of a consumer since he has been in the occupation of the house.

Mr. Benson: Assuming that he is the occupier of the house, he is a consumer within the meaning of the Act. No doubt there is considerable common sense in the desire of the company for security, but I believe it is illegal, and therefore my decision upon this point must be against you. There is the question of service of summons upon the secretary, but you had better waive that. In stating a case I should assume the service correct.

Mr. Edwin: We will take the service as correct.

Mr. Benson: What is the position of this man? I suppose he has the house and has invested money in it. Is he to be without gas?

Mr. Lilley: He offered £5 in the first instance. Is not that a reasonable sum for him to deposit until the decision of the case?

Mr. Benson: I cannot force it upon him. The company will now refuse to supply him with gas at their peril. If they are prepared to do it, I have nothing to say. At the present moment they have incurred certain penalties, and every day they fail to supply him with gas they incur fresh penalties. I shall not say now what penalty I shall inflict, and I will give them a month to consider if they will supply the man with gas.

Mr. Lilley: I want you to bear in mind, as part of the case, that this man is in possession of a beer-house for which he has no licence. He is not in the position of a man who, having a licence, could carry on his business but is hindered by us.

Plaintiff recalled, said, in answer to the magistrate, that he was selling beer though the licence had not been transferred. He did not know that he was incurring penalties for so doing. He had taken the house for three years, and expected to get the business settled on the following Monday.

Mr. Benson: The judgment of the court is, that the Surrey Consumers Com-

pany are convicted under the 17th section, and I adjourn the matter until next Tuesday.

TUESDAY, JULY 26.

Mr. EDWIN said he had only to ask his worship to allow the case to go to quarter sessions. He might state that, acting under his advice, the company had supplied the plaintiff with gas.

Mr. BENSON said he thought it was the wisest course.

Mr. EDWARDS said, as the complainant now had a supply of gas, he should not ask his worship to inflict the full penalty to which the company were liable. He only asked as much as would cover the expenses.

Mr. BENSON: I must inflict such a penalty as will give them the right of appeal. I should have preferred the question going before the judges. With all respect to the quarter sessions, I cannot help feeling that an appeal from a police court to three country gentlemen, sitting at Newington, is not particularly strong on a point of law. If I were told I was wrong, I should not feel so much confidence in the review of my opinion; but if the judges decide I am wrong, there is an end of the question directly.

Mr. EDWIN, after that expression of the wish of the court, asked that the point might be again adjourned, to allow the directors of the company to be consulted.

Mr. BENSON consented, and said he should fine the company in the sum of 10s. per day for seven days, and allow one guinea for costs in addition to the summons.

FRIDAY, JULY 29.

Mr. EDWIN said it was not the wish of the directors of the company to carry the case to another court, consequently they would abide by his worship's decision; but in awarding the costs he had to inform his worship that the complainant was trading without a licence, and therefore was breaking the law. The licence had never been transferred to him.

Mr. EDWARDS said his client held the former tenant's licence, and it would be transferred as soon as the magistrates sat again at petty sessions. He was carrying on business in the other tenant's name.

Mr. BENSON observed that he certainly could not look on the complainant as a licensed beer-seller, as he had no licence. He should, therefore, treat him as a private consumer. Under the provisions of the Act the company were bound to supply him, as he was the occupier of the house, and must be treated as a consumer. The defendants must pay him 30s. for not supplying him with gas, and 23s. costs.

Miscellaneous News.

STRIKE AMONG THE WORKMEN AT THE GLASGOW CORPORATION GAS-WORKS.

On Friday week the workmen in the employment of the Corporation Gas Committee made a demand for an increase of wages to the extent of 6d. per day, with the further stipulation that the amount of work they are at present called upon to perform should be considerably reduced, six men being told off to do the work previously done by four. With this demand the Gas Committee peremptorily declined to comply, and at a meeting held on the Green on Saturday forenoon the men resolved to refuse to return to their employment. The rate of wages paid by the corporation for some time past has been 5s. per day, a rate, it is said, a good deal higher than that given to the same class of men by any gas company in the kingdom. The staff employed in the Glasgow works is also said to be larger, in proportion to the number of tons of coal carbonized, than in any similar establishment. The *employés*, on the other hand, allege that the wages paid in England are considerably higher than those they receive, and they further assert that the amount of work required of them has been greatly increased since the works came into the hands of the corporation.

With regard to the first demand, it is stated that the rate of wages paid is considerably higher than in the English towns; that in Newcastle, for example, the men receive 34s. 6d. a week, and are required to carbonize 4 tons 10 cwts. of coal per shift, while in Glasgow the men receive 35s. per week, and carbonize only 2 tons per shift. Various changes have lately been introduced by Mr. Foulis in the conduct of the manufacturing operations, and these, it is believed, may have at first proved a little irksome to the workmen. But while their chief object undoubtedly is to secure economy in the manufacture, it is believed that they will in the end conduce to the comfort of the men. One class of men, for example, are now required to attend to the retorts when charged; while on another devolves the duty of firing and withdrawing the coke, instead of these duties being performed by the men indiscriminately as formerly. Another improvement consists in the introduction of ponies for conveying the coal to, and the coke from, the furnaces, so that the workmen will be enabled to avoid the sudden alternations of heat and cold to which they have hitherto been exposed.

Temporary arrangements were at once made for carrying on the works by pressing a number of the men connected with the cleansing department into the service. On Monday afternoon a deputation from the men on strike waited upon the Lord Provost, at his chambers, and submitted their grievances for his consideration. In the afternoon, the Lord Provost, along with Bailie Burt and Councillor Moir, members of the Gas Committee, had an interview with the delegates from the three works, within the offices of the Gas Committee. Mr. Foulis, the manager of the works, was also present. Having heard the statement of the delegates, and the explanations of the manager, the committee, being fully persuaded of the justice of the position the manager had taken up, declined to accede to the terms desired by the *employés*, leaving Mr. Foulis to fill up the works with other men with all convenient speed, a task which he expected to have little difficulty in accomplishing. At that time he had obtained as many as were required at the Tradeston works; at Townhead, men were coming in rapidly on the previous day; and at the Dalmarnock works, arrangements were also being made for filling up the places of the men on strike. Telegrams were received on Monday morning to the effect that 200 men could be sent down from England on a day's notice; but it was resolved that an effort should be made, in the first place, to fill up the works without going beyond the bounds of the city.

On Wednesday the strike was virtually at an end. On that day a deputation of the workmen waited upon the Lord Provost, and intimated their readiness to return to their employment provided they were taken in as a body. With this condition his lordship declined to comply. The men, he said, must apply individually to the manager, who would consider each application on its own merits. We understand that at the Townhead works a number of the men have resumed work on the terms proposed by Mr. Foulis.

LEWES.—The continued increase in the consumption of gas in this borough, and the improvements in its manufacture, have enabled the directors to reduce the price by meter from 4s. 7d. to 4s. 2d. per 1000 feet, to take effect from the 24th of June last.

MR. T. W. KEATES, who since March, 1869, has filled the office of gas examiner to the Metropolitan Board of Works, was on Friday, the 8th ult., appointed consulting chemist and superintending gas examiner to that body.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page 524.*)

WEDNESDAY, JUNE 8.

The PRESIDENT took the chair at eleven o'clock this morning, and the first paper read was by Mr. F. W. HARTLEY, entitled:—

REMARKS ON PHOTOMETRY.

In common with most persons who have had much to do with photometry, the writer laments the defects of the present system, and would gladly welcome any modification of it, or any other system of estimating the illuminating value of artificial lights, which would ensure a degree of accuracy alike satisfactory to the mere business man who wants to find whether the article which he is selling or buying, as the case may be, is of the proper quality, and to the scientific investigator whose object is to accumulate facts from which to deduce general laws.

While, however, ready to accept anything which is new, providing only that it be of the character just indicated, and while warmly sympathizing with those whose efforts are directed to the invention of new photometers and new standards of light, the writer inclines strongly to the belief that for a long time there has been a growing disposition to undervalue and decry the present system of photometry, and to exaggerate its defects. Indeed, it has become almost a fashion to regard the results of the present system as of the least possible, or even as of no value, because they, like the results of most experimental investigations, are but approximations to the actual truth.

It is true of photometrical as of other experimental results, that the degree of approximation to truth depends very much upon the intelligence, the judgment, and the skill exercised by the investigator. Now, although it may seem almost heresy to say so, there is possibly less of those qualities exercised generally in photometry than in any other experimental investigation; because, in the first place, it is too much the fashion to regard the operations of photometry as being merely mechanical—demanding only a certain amount of visual experience and skill, and in the next place as being unworthy of the serious attention of the man of science, owing to the untrustworthiness of their indications.

That the matter is pretty much in the condition which the writer has assumed, would appear evident from a fact which has on several occasions come under his notice, which is that some so-called "good operators" will rest quite satisfied that a fair and proper experiment has been made when the light from a 5 feet per hour gas-flame has been compared ten times in as many minutes with the light of one or of a pair of sperm candles, and the rate of the candles consumption ascertained and correction made for variation, if any. Sometimes such operators may repeat the ten minutes experiment, but the chances are much against any change being made with the candles.

In this respect even the gas referees, who, by virtue of their official position, must be accepted as the highest authorities on photometry, have not thought it at all needful to lay down instructions; for, although they order two candles to be used at one time, they do not specify that a different pair shall be used in each comparative experiment, but merely say that "the candle shall be sperm, and two candles shall be used together."

"The standard rate of consumption for the candles shall be 120 grains each per hour. Before and after making each set of ten observations of the photometer, the gas examiner shall weigh the candle, and if the rate of combustion hall have been more or less per candle than 120 grains per hour, he shall make (and record in the above-mentioned book*) the calculations necessary to neutralize the effects of this difference." And again: "The average of each set of ten observations is to be taken as representing the illuminating power of that testing; and the average of the three testings is to be taken as representing the illuminating power of the gas for that day."

In the experimental determination of the products of coal by distillation in small quantity, it is, as is well known to the members of this association, usual to reduce a considerable mass to small fragments, and from such mass to take three distinct samples for as many distillations—the mean of the results so obtained being accepted as indicating as nearly as may be the characteristics of the coal. The writer is well assured that no gas-maker would attach the least degree of value to an experiment made upon one special lump of coal.

The candle, is like coal, a compound body, both chemically and physically, and in the process of burning is converted into gases and vapours just as the volatile portions of the coal are on distillation, only that in the case of the candle there is no sensible interval between the distillation and the combustion of the material. Now it is well known that in the case of coal, although the chemical composition of two samples may be identical, yet that what appear to be but small differences in the conditions of distillation modify to a considerable extent both the character and the amount of the products. So it may be with candles, the sperm may be apparently identical in composition, and the wicks be alike as to quality of cotton, number and size of its strands, &c., and yet, owing to causes of an obscure nature, the rate of burning or the light yielded by any two may not be, and indeed is almost certain not to be exactly equal. Hence in photometry it is necessary, as it is frequently in the chemical analysis of various bodies, to accept the mean of the results obtained by operating on different samples, and it is utterly unwise to depend on any experiment made with one candle only. Moreover, just as the trustworthy analyst would be careful to obtain fair samples of coal, so should the photometrist be careful to select his sperm candles.

At first the idea of selecting the candles may seem to involve the conclusion that the operator might make the gas to appear good or bad at will; but in fact the selection would have just the contrary effect, and would narrow the boundaries within which errors might be made. The elaborate experiments of Mr. Kirkham on "the standards of comparison employed for testing the illuminating power of coal gas,"† also appear, on first examination, to prove that the defectiveness or variation in the value of the candle's light is so gross as to render the candle standard utterly worthless, and consequently any great care expended upon it a mere waste of time and trouble. But a re-examination of Mr. Kirkham's experiments induces a somewhat different view of the matter.

That gentleman found an extreme difference of 4·59 candles in the illuminating power of the same gas, as compared with different candles, and after correction for the rate of consumption of the latter; but the candles were indiscriminately obtained from various makers, without regard probably to their fitness for photometry, and the consumptions ranged far below and far above the parliamentary rate—viz., 109·2 and 134·4 grains per hour. The after experiments show that with other sperm candles and with a reasonable variation in the rate of consumption, that is, between 118·1 and 129·1, the variation amounted to 1·27 candles only. It is true that in the first series of experiments, with consumptions of 120·1 and 129 grains, the difference in the value of the gas was shown as 1·7 candles; but then the candles were, as before said, indiscriminately purchased, and moreover the differences in the first series are more extreme than in the later experiments.

With candles consuming the same quantity of material, but giving different amounts of light, the greatest difference was 2·28 candles, the consumption being 134·1 and 134·4 grains, and 2·3 candles with consumptions of 142·5 grains; in both cases far above the standard rate. When the consumption is nearer to the latter rate, as shown in Mr. Kirkham's diagram 7A, experiment 16, consumption 129·6 grains, the difference was only 0·43 candle; and as shown in diagram 10B, experiments 44 and 47, consumption 126 grains, it was 1·13 candle.

* A book named in the referees instructions.

† Proceedings of the Institution of Civil Engineers, April 13, 1869.

With candles giving the same amount of light with different consumptions, he found the greatest difference in the value of the gas to be 3·53 candles, but the consumptions ranged from 109·2 to 140·1 grains. On comparing the results obtained with candles burning nearer to the standard rate, as in diagram 10B, experiments 50 and 48, consumptions 126 and 131 grains, the difference was only 0·56 candle; and even as in diagram 7A, experiments 16 and 15, with consumptions of 129·6 and 134·4 grains, the difference was 0·39 candle only.

Thus it appears from Mr. Kirkham's experiments that within reasonable limits of consumption—that is, from 118 to 125 or even to 129 grains per hour—the errors in the estimation of the illuminating value of gas, when tested once only, are not likely to exceed 1¼, or, at the very utmost, 1½ candle—a possible error which the writer is by no means disposed to pass over lightly or to treat with indifference; on the contrary, it confirms him in the conviction which he has long held, that when exactness is required, and especially when tests are made against a gas company, the results of which may subject the company both to pecuniary penalties and to discredit, no photometric estimation of the value of the gas should be accepted which was based upon less than three or even four consecutive experiments with different candles, each experiment lasting for at least ten minutes, so that an operator might easily make the whole test in one hour; or if, as in many country towns, this would involve too much labour, if done in one evening, the examiner might make one trial on each of four evenings in a week, and then the average of the whole would represent the illuminating value for the week.

If, in such a series, one of the experiments should work out very discordantly with the rest, that experiment should be rejected, and a fresh experiment be made, or, if that be not possible, a mean taken from those experiments which were nearer in agreement. Such a practice would go far towards securing agreement between the results of different operators.

There ought also to be a limitation to the extent of deviation in consumption from the standard rate. The referees at first imposed a limit, but it was much too narrow, as it permitted a deviation of 5 grains per candle per hour only. A practical limit would be between 117 and 128 grains. Part of the trouble with sperm candles doubtless arises from the parliamentary but absurd stipulation that they shall be of the size of six to the pound. The candles are in consequence of considerable length—8¾ inches—and from necessity the difference in the diameter at the two ends is much greater than would be needful were the candles made twelve or any other convenient number to the pound. The diminished length would also permit of a more perfect centering of the wicks. These changes would tend to diminish irregularities in burning.

In respect to the selection of candles for experiment, there are certain appearances about a good sperm candle when burning (and all must be burned preliminarily, to get them into a proper condition for use) which go far to show whether the candle is or is not a fair specimen. These appearances can be much better practically illustrated than described, but the writer may mention some of them. The candle should burn with a shallow cup, and the sperm within an eighth of an inch of the top of the candle should, after it has been burning some time, be firm, and bear a good squeeze between the finger and thumb without yielding to the pressure. The wick should appear somewhat small and compactly woven, and not bend to an exceeding degree out of the upright. Lastly, on looking down into the sperm cup, there should appear to be a number of radial dashes (something like the dotted lines in a drawing, but much more irregular), extending from the wick to the circumference. If a candle contains paraffin or stearine, some or all of these peculiarities are wanting. The cup will be deeper, its edge will soften and give way on a very slight pressure, the wick will be generally larger, and there will be no appearance of radial lines in the sperm cup. The peculiarities mentioned apply in part, however, only to candles which have been made some little time. Candles which are quite new generally burn somewhat irregularly, and the radial dashes in the cup are mostly absent, doubtless owing to a temporary disturbance of molicular arrangement, consequent on the heating of the sperm when the candles are made.

The conditions under which a candle is burned exercise a material influence on the amount of light which it yields, as well as upon the rate of consumption and uniformity of the light. The atmosphere surrounding it should be tranquil, otherwise the candle is almost certain to form an irregular cup, to gutter, and to smoke. If in a tranquil atmosphere the candle burns thus irregularly, it is an evidence of its unfitness for photometrical use. The candle may be fairly protected by screens from draughts, but not, the writer thinks, absolutely enclosed in a box, inasmuch as, when so enclosed, the surrounding air may (unless, indeed, the box be enormously capacious) be somewhat heated, the supply be not so free, and the candle be burned, in consequence, under abnormal conditions. Moreover, when so enclosed, its condition is not so readily observed by the operator.

Another important matter is the accurate determination of the rate of consumption of the candles. The writer is fully aware that most photometrists take the utmost care in this matter, and find the rate even to the 100th of a grain; but there are some who are content to use scales not capable of weighing closer than half a grain. Now if, for the sake of argument, it is admitted as a fact that, within certain narrow limits, the light yielded by a candle is in direct proportion to the quantity of material consumed, then such a defect in weighing, with one candle and ten minutes as the time of burning, would induce an error of 2½ per cent., which, in 14-candle gas, would amount to more than a third of a candle's value.

The method of weighing the candle before lighting, using at the photometer, extinguishing, and reweighing, should be utterly discarded; not on the ground that the weighing may be inaccurate, but because the candle cannot, in an instant, be completely put into a proper state of burning, and consequently the readings of the photometer during the first two or even three minutes will be much above the real comparative value of the gas.

The real lighting value of a candle may be considered as the average of its light during the whole time it burns, and as the average of its light during the first ten minutes after ignition would be undoubtedly considerably lower than the average for the whole time during which it is capable of burning, it is manifestly unfair to employ the candle under the conditions mentioned.

Even the ordinary system of weighing the candle while burning at its best, then removing it from the balance to the photometer, and thence again in due time to the balance, is objectionable—first, on account of the needless trouble thrown upon the operator, and, more importantly, on account of the liability to disturb the regularity of combustion by the necessary motion, and also to destroy an experiment by the dropping or spilling of sperm.

The only method of weighing which is at once rational, facile, and accurate, is that in which the candles are weighed *in situ;* that is, while in position for photometric comparisons. This method was first practised by Mr. Keats, who constructed and affixed to the photometer-bar itself a specially formed balance.

A point which is made the most of by the objectors to the present system of photometry is the variation in the sensibility of the eyes of the operators; in fact, the referees say that "a slight variation in the sensibility of the eye of the gas examiner may easily make a difference of half a candle in his recorded testings."

Granting for the moment that this may be the case, it only shows the necessity for repeated series of observations, in order to obtain an average which may be regarded as truthful; for it is hardly to be conceived that the variation in sensibility would continuously give an error in one direction, and consequently if three or four sets of ten observations be made, it is almost impossible to doubt that accuracy would be very nearly, if not absolutely, attained. The writer is, however, somewhat sceptical as to the variation in visual sensibility lasting with an operator for more than a very limited time, as he is also as to the existence of any material difference in visual sensibility between different operators, if they be experienced.

It is true that differences do arise, but the wherefore is by no means satisfactorily settled. Judging from his own experience, the writer is convinced that were a skilled photometrist (with the graduations of the photometer-bar hidden from his sight, but visible to another observer, who should note the values) comparing lights of unvarying intensity during a considerable time, it would be found that the average intensity, as deduced from any one set of ten consecutive readings, and the average as deduced from any other set of ten consecutive readings, would be very close the one to the other, if not actually identical.

Further, that if each of two photometrists were at the same time comparing against a single flame common to both, the light from one of two gas-flames, which were maintained exactly equal to each other, and of uniform intensity, it would be found that, although the averages of a few readings might differ, the averages of a greater number would approximate very closely. In proof of which he may cite the results of some trials upon gas of varying quality (uniform quality not being obtainable), and with different candles, but each candle common to both photometers, which trials were made by himself and by a no means practised photometrist. These trials were made in a perfectly fair and proper manner, and each observer took his own readings, without the least reference to what his opponent was doing or finding.

The following are the averages of sets of ten readings, the operators being designated A and B:—

No. 1 ..	A 18·14	B 18·3	Difference	0·16
„ 2 ..	„ 18·75	„ 19·2	„	0·45
„ 3 ..	„ 18·8	„ 18·75	„	0·05
„ 4 ..	„ 16·1	„ 16·1	„	0·0
	4)71·79(=17·95	4)72·35(=18·09		
	Mean difference			0·14

No. 1 ..	A 14·875	B 14·875	Difference	0.0
„ 2 ..	„ 15·175	„ 14·95	„	0·225
„ 3 ..	„ 16·05	„ 16·085	„	0·035
„ 4 ..	„ 13·9	„ 13·67	„	0·23
	4)60·000(=15·0	4)59·58(=14·895		
	Mean difference			0·105

This is by no means a special experience of the writers; he has on many occasions, and with different persons, arrived at similar results, although not quite so satisfactorily, inasmuch as a single photometer has been employed, and consequently it was not possible for both operators to take readings at the same time.

The simultaneous determination of illuminating value by several persons is both interesting and valuable, and it would be well were every individual, previously to being appointed to the office of gas examiner, compelled to go through a course of practice with a skilled operator, and upon duplicate instruments. By such a procedure the visual fitness or otherwise of the individual would be determined, and his mind impressed with a due sense of the nature of his duties.

Mr. Kirkham's "cross" photometer, which he employed in making the experiments already referred to, permitted four persons to make observations at the same time; but, admirably as that instrument was adapted for the purpose of the experiments, the discovery of the degree of variation in the light given by sperm candles and by carcel lamps, it is quite unfitted for the determination of the amount of error, if any, due to differences in visual sensibility between operators, and simply for the reason that with it the flame to be tested, and not the testing flame, is common to all the operators; in other words, the gas-flame is in the centre of the cross, and each operator must use a different candle or lamp.

For the purpose of finding the extent of the possible or probable errors between operators, the candle or other standard of light must occupy the central position. Such an apparatus the writer was requested some time since, by Mr. Somerville, of the Alliance and Dublin Gas Company, to construct, that gentleman wishing, among other things, to have the power of testing simultaneously the gas as soon as made, the gas in stock, and gas made experimentally. It was to consist of three photometers converging to a common centre, and to embrace any novelty or improvement which the writer could devise capable of facilitating the investigations and of securing accuracy. This apparatus has lately been completed, and will be submitted to the inspection of any members of the association who are sufficiently interested to pay a visit to 55, Millbank Street, the apparatus being of such a character as to render its exhibition in a public hall scarcely possible. The points of novelty consist in the general arrangement of the parts, in the construction of some of them, and in the employment of electricity for timekeeping; each photometer being as usual provided with meter, governor, micrometer, King's gauge, &c., and each meter having combined with its index an electric time indicator, a fourth time indicator being provided for timing the rate of the consumption of the candle, which is suspended *in situ* from the end of a balance-beam in the manner devised by the writer some years since. The time indicators are controlled by an accurate clock, beating dead seconds, and the weighing of the candle is automatic, for as soon as any predetermined number of grains of sperm have been consumed, the time indicator stops, and the operators are informed by an alarum that the time is up. The operators have complete command over these time indicators, each one of which may be set going and stopped at will, without in the least degree interfering with the others. As the meters of this apparatus agree exactly with each other in registration, and as the time indications must also of necessity be synchronous, and one standard of light is common to all the operators, it follows that the elements of error are reduced to two only, which are differences in the visual sensibility of the operators, and differences in the light-developing power of the several burners.

The latter element may, of course, be readily eliminated by a few experiments, and the per centage of difference, if any, allowed for in after experiments, so that any apparent differences in the results must be attributed to errors in the operators themselves. Such an apparatus is not only valuable as an agent for instruction, but inasmuch as each operator is working, as it were, competitively with others, unflagging carefulness is ensured, and hence the experiments must be of a specially reliable nature—that is, if several trials with different candles have on each occasion been made.

It would be well if some such system of duplicate or triplicate testing could be carried out on all occasions. No doubt, however, there are difficulties and objections in the way.

There are some other objections urged against the present system of photometry. One is, the time which is occupied in making a proper experiment; another, the trouble there is in doing it; and a third, the intermittent nature of the test, and that it only relates to a small portion of the whole time during which gas is being consumed.

These objections cannot be denied or even disputed; but, apart from them, the writer thinks the system as now carried out generally worthy of some considerable admiration, and entitled to a high degree of, if not to complete, confidence. It is undoubtedly not perfect, but it has the special merit of appealing in understandable language to the minds of those who are, in respect to

their being the greatest in number, the most interested in gas-testing—namely, the general public of gas consumers, who, although they may know little or nothing about the details of the experiment, are quite able and willing to believe in that valuation of a gaslight which is made by contrasting it with the light of a candle.

At the same time the writer must admit that it is most desirable that a better, simpler, more philosophical, and more continuous method of testing gas should be sought for, and when found adopted. Of all proposed methods, that in which the jet photometer is used, to show length of flame in connexion with specific gravity and durability, is most entitled to confidence. It was one of the earliest and best means used for comparing the relative values of gases. When last year, at the Institute of Civil Engineers, the writer heard Mr. Kirkham's paper read, and imperfectly heard or understood one part, he objected to the jet photometer as a standard test; but his objections applied more to what he conceived to be the proposed method of using it than to the instrument itself, and he then distinctly said that when used as a durability test it is of the greatest value to the scientific experimentalist. Being now fully aware that Mr. Kirkham proposes to use the jet in the truly philosophical manner, the writer's objections are for the greater part overcome, but he is certainly still obliged to hold to the opinion that the jet photometer is "not an instrument to satisfy the public," and dissatisfaction would especially be felt in country places. Under existing circumstances, litigious consumers may be often satisfied by an imposing process of comparison of a gas and of a candle light. The whole matter looks so commonplace and reasonable that it leaves scarce room for disputation; but if a jet photometer were put forward in proof of quality, would there not be, as the writer has before asserted, doubt and mystification? The writer is quite sensible that what he has said forms by no means a weighty argument against the jet when properly used. If it be fitted for a standard test, it will become so in spite of objections; but before it can be accepted for such purpose, the following, and possibly some other questions, would have to be decided.

The agreement or extent of difference in the indicated illuminating power of gas, as determined by the Bunsen and by the jet, under different atmospheric densities, under various temperatures, and with carbonic oxide in varying proportions in the gas.

In ordinary photometry it is well known that the same light cannot be obtained from a 5 cubic feet per hour gas-flame in an atmosphere of 29 inches density as in an atmosphere of 30 inches, because, in the first place, a lesser weight of gas is consumed in a given time (5 volumes at 29 inches containing in weight an equivalent to only 4·833 volumes at 30 inches); and secondly, because in a dense atmosphere flames tend to give more light, Dr. Frankland having proved that even those gases which, under the usual atmospheric pressure, give *no* light, can, in very condensed atmospheres, be made to and do give a considerable amount. Now, in ordinary photometry, the quantity of gas is limited to 5 cubic feet consumption per hour, whatever be the atmospheric density, and, reasoning from analogy, it appears probable, although it remains yet to be proved as a fact, that if the magnitudes of the flames for 5 cubic feet could be accurately measured, it would be found that their dimensions varied only to a trifling extent; for as the atmospheric pressure becomes reduced, so must the flame expand to some extent in bulk—that is in length and breadth —just as in what are called vacuum-tubes (which are really tubes containing a very attenuated atmosphere) electric sparks, which in the open air are minute and intensely brilliant, become expanded, and appear almost like discs or circles of phosphorescent light.

The jet photometer is affected in two ways by a change in atmospheric density. If the density diminish, the gas is attenuated, and the weight of combustible and light-giving matter in a given volume reduced, and as a consequence a larger volume tends to escape from the jet orifice under the same acting pressure. Secondly, there is the natural increase in the bulk of the flame, owing to its burning in a more rarefied medium.

In respect to the first effect, let it be assumed that a gas whose specific gravity is 400 be discharged into the atmosphere, when its density is 30 inches, at the rate of 2 cubic feet per hour, then with no other alteration than a reduction of atmospheric density to 29 inches the rate of issue would be increased to 2·034 cubic feet per hour, the rate of discharge being in the inverse ratio to the square roots of the gravities, which would be 400 and 386·8, and the roots 20 and 19·67. Thus the rate of discharge would be increased to the extent of 1·7 per cent. in volume, although the *weight* of combustible matter in the increased volume would be less than that in the 2 feet at 30 inches.

Thus it *might* be possible for the gas to be indicated, under one atmospheric density, as of one and the same illuminating value, by both the jet and the Bunsen photometer, and yet for the indicated values to be different under any other atmospheric density. The illustration refers particularly to reduction in density of atmosphere, but, of course, the reasoning applies with equal force to increase of density.

The durability test, pure and simple, may not be entirely free from possibility of error, for although the determination of value is dependent on time and volume, or, what is the same thing, on the rate of consumption, yet if flames produced by consumpts of equal weights of a combustible become enlarged and reduced as the atmospheric density diminishes or increases, it may be that equal volumes of gas will at different atmospheric densities produce flames of equal lengths, and thus lead at times to the under or over estimation of the illuminating value of the gas.

On further consideration, it would also appear that there must at times arise some disagreement between the indications given by the jet photometer itself; that is, between its indications when used in accordance with the asserted law, that, "maintaining a 7-inch flame from an orifice of fixed dimensions, the illuminating power of the gas is in direct proportion inversely as the pressure," and its indications when used to determine "durability." For, as it has been already shown, an increased volume tends to escape from the orifice, under the same acting pressure, when the atmospheric density is reduced, and no notice is taken of such increase, while with the durability test the quantity is fixed, and the time for its consumption determined. Now if, as seems probable, the increased rate of consumption by volume, in the one case, simply maintained the flame at the 7-inch length, it is manifest that a given volume—say the tenth of a cubic foot—could not maintain a 7-inch flame under the same acting pressure at 29 inches for so long a time as that quantity of the same gas would do at 30 inches atmospheric density. Hence while the one test showed the gas to be up to the standard value, the other test would exhibit the gas as below that value. No such possible discordance must exist in a new photometric standard.

In ordinary photometry the candle-flame is also affected, without doubt, by changes in atmospheric pressure, and it may be in nearly the same ratio, both in respect to weight of material consumed in a given time (although on this point the writer is very doubtful), and the amount of light yielded. If so, an argument might be established thereon in favour of the system of comparison of artificial lights. For if these be equally affected by atmospheric changes, the normal relations between any two or more would at all events be at all times easily determinable.

Atmospheric temperature also exercises an important influence in respect to the jet, although not to the same extent as density. Temperature can moreover be to a considerable extent controlled in testing-rooms.

Carbonic oxide increases the gravity, whilst it certainly is much more likely to diminish than to enhance the illuminating power. Its gravity is ·9678 (olefiant being but ·9713), and although it is true that on ignition it gives out a considerable amount of heat, it gives by its own combustion little or no light, and is instantly converted into carbonic acid. So that its influence on the density and illuminating power of coal gas must be important, the per centage which London gas contains appearing from Dr. Frankland's statements to range from 7 to 9 per cent., and in some other towns even to above 10 per cent. Carbonic acid and ammonia have not been named because the gas ought to be free from these impurities, or at all events contain but a trifling quantity of either.

These observations are not made in a spirit of antagonism to the jet photometer, but only with a view to sweep away causes of error.

The degrees, so to speak, of the jet photometer scale are so narrow—a variation of ·025 of an inch water pressure being sufficient to determine a difference equal to the light of an entire candle—that it is important, if it is to be used for the purposes of public testing, that every element of error be eliminated.

A better system than that commonly practised is wanted, but before a change is made it is advisable that photometry generally should be subjected to a most exhaustive inquiry, so as to avoid any danger of falling into one evil while escaping from another.

Whatever be the future system of testing the illuminating power of coal gas, it must, in order to serve the interests of the consumers generally, be quite as facile in application as the present system, and be of a simple character, so as to render the test available, not only in the large towns and cities, but even in the smallest village of the United Kingdom in which gas is used.

Mr. ALFRED UPWARD read the following paper:—

ON THE ECONOMICAL PURIFICATION OF COAL GAS.

Having been requested to write a paper for this meeting, I think that one of the most important subjects to which I can call your attention is that of "The Economical Purification of Coal Gas." It is well known that for many years past gas companies in large towns have been compelled to abandon the use of wet lime purification owing to the great difficulty of getting rid of the "blue billy," as it was called, and in order to overcome this difficulty dry lime purification was commenced, but in a very few years the inhabitants surrounding gas establishments made such serious complaints as caused gas companies to look out for some other material which would remove the nuisance complained of; and it was shortly after this date that the oxide of iron purification became general. This last plan gives no cause of complaint, but it is, nevertheless, a more expensive plan than the old wet lime purification, and at the same time, if only the oxide be used, it does not purify the gas from carbonic acid. Now, if this last-named impurity be present in the gas it destroys to some extent the illuminating power, so I think it is evident that if some plan could be adopted to overcome, or considerably lessen the expense of either dry lime or oxide of iron purification, and at the same time render the gas free both from sulphuretted hydrogen and carbonic acid, a great point would be gained. My object in calling attention to this matter is that, having been invited to inspect a plan lately invented by Mr. F. C. Hills, of Deptford, I felt that a description of that plan might be useful to some of the members of this association, and I am thus induced to lay before the meeting a few facts relating to this important subject. It has been long known that caustic ammonia will purify coal gas, but no plan has hitherto been found by which liquid ammonia could be obtained of sufficient purity and cheapness to purify gas until Mr. Hills made the way clear. The plan he adopts is to make the ammoniacal liquor produced at gas-works of sufficient purity to become a cheap and effective purifying agent for depriving gas of its sulphuretted hydrogen and carbonic acid. The gas liquor being made on the works is always ready for use, and when purified by the process hereafter described, is run through the common scrubber, and the gas allowed (in the usual way) to pass up through the scrubber. It then comes in contact with purified ammoniacal liquor, which deprives it of its impurities, and thus the desired result is obtained, and all expense of excessive labour is put to an end.

The mode Mr. Hills employs to purify the gas liquor is as follows:—He uses a series of stills or vessels placed one above another, which vessels are partly filled with the gas liquor to be purified. The gas liquor runs through these vessels by means of connecting pipes from the top to the bottom. In the bottom vessel the gas liquor is caused to boil. By this boiling the carbonic acid and sulphuretted hydrogen, in combination with the gas liquor, are driven off to a great extent, and also a little ammonia; these products are caused to pass into the liquor in the next vessel above, by which the ammonia vapour is mostly absorbed, but not the carbonic acid or sulphuretted hydrogen, and, by passing these products in like manner through the whole series of vessels, the ammoniacal vapour driven off from the boiling gas liquor is absorbed by the gas liquor in the higher vessels, and the carbonic acid and sulphuretted hydrogen are left free to pass away wherever desired. The hot purified gas liquor, as it runs out, heats the cold gas liquor which is to be purified by passing in opposite directions through a series of pipes, so that very little heat is required fo purifying the gas liquor. If wished, the whole of the gas may be purified entirely by this gas liquor, but as the quantity required would be considerable it is perhaps best to purify the gas about two-thirds by this process, and then to finish the purification with oxide of iron. When the purification of gas is effected by means of liquid in scrubbers, it becomes of great importance to secure a good spreader of the liquid over the surface of the media contained in the scrubber. Mr. Hills has contrived a new spreader, by means of which the liquid to be used can be caused to spread quite evenly, and in the exact proportion required, over every part of the surface of the media contained in the scrubber, so that no one part shall have a greater proportion of purifying liquid than another. By this means a minimum quantity of liquor can be made to do its maximum quantity of work.

It thus appears that the present plan promises all the advantages of the old wet purification, whilst at the same time the products of the improved method are valuable, and will pay for their removal, and, in addition, be a source of profit to the gas company. It is simple in operation, and the gas manufacturer has at his own command the purifying agent required.

I may add that this plan is now being experimented upon by Mr. George Livesey, who was the inventor of a plan somewhat similar to that now described.

As to the surface required, it is expected that the present scrubber surface at the South Metropolitan Gas-Works will be sufficient to purify the gas made at those works, so that in adopting Mr. Hills's new plan no additional expense will be incurred at that station in purifying surface.

Mr. GEORGE T. LIVESEY read the following paper:—

ON SCRUBBERS.

It is of very little use going to "Clegg on Gas" for information on any modern invention introduced within the last 20 or 25 years. Newbigging gives the pith of Clegg's article on "Scrubbers" in one laconic sentence, which, after all, refers more to the mechanical filtering or separation of the tar than to the extraction of ammonia and other impurities.

Newbigging tell us, quoting from Clegg, that, "for every 1000 feet of gas produced in 24 hours, one cubic foot of wet scrubbing material is required," which is certainly rather vague. Let me here observe that I say nothing in disparagement of our late auditor's work; on the contrary, I am bound to speak very highly of the book he has published, as containing a mass of valuable and reliable information that will be of use to every manager.

An endeavour has been made to trace the first introduction of scrubbers, but without success. It seems probable that a Darwinian system of development, if not of natural selection, has been in operation. All the older gas men remember the tar filters, or breeze boxes, as they were sometimes called, that were in use 20 or 30 years ago—vessels constructed like ordinary purifiers, but filled with

coke or coarse breeze, through which the gas passed after leaving the condenser or washer, in order to arrest the lighter tar that would otherwise be carried forward into the purifiers, an object that was successfully attained by these means. The spent tan from the tan yards was sometimes used instead of the coke, with a very good result.

This might be called a scrubbing process; but the origin of the term is obscure, so is the first use of water to absorb the ammonia, though it is more than probable that the ammonia manufacturers were the first to suggest its use. The transition from breeze boxes or tar filters to scrubbers was accomplished merely by increasing the depth, and allowing water to trickle through; but only a small quantity of water being required, the difficulty was to distribute it equally. To meet this, Mr. F. C. Hills, of Deptford, adapted the well-known "Barker's mill" (one of which is now in the room) to the purpose, but even this ingenious contrivance was not sufficient of itself; it distributed the water equally, but the quantity required to keep it going made the resulting liquor too weak to be profitable. Hills then introduced a tumbler, as it was called—a sort of double trough, or an oblong pan or dish, with a division across its centre, and so balanced over an open box that the small stream of water alternately filled first one division and then the other, the division into which the water runs remaining in position until it is filled, when it is, so to speak, overbalanced, and tumbles over, emptying its contents into the box, and thus affording a sufficient quantity of water to cause the Barker's mill to turn for a minute or two, which stops when the supply is exhausted. In the meantime the other division is filling, and in its turn tumbles over, and gives another supply of water to the mill; a very small quantity of water was thus supplied at regular intervals, and distributed equally to the scrubber.

The Barker's mill is not much used now, though I decidedly consider it the best of all the distributors that have been invented, the chief difficulty arising from the small holes getting stopped, which was an almost daily occurrence; hence its disuse. The tumbler, also, is not often seen, though it did its work well, its only drawback being the periodical knock which it gave every time it fell, and the vibration thus produced rendered it difficult to prevent a constant leakage of water from the joints. It is more than 20 years since Hills introduced the Barker's mill and tumbler. Ammonia at that time was beginning to rise in value, and scrubbers for its extraction were being brought into use, thus superseding the original "washer," which had hitherto been used to remove the ammonia. It was effective for the purpose, but the drawback to its use, when clay retorts were introduced, was the pressure it gave. The scrubber, therefore, in modern gas-works, does the work for which two separate contrivances were employed formerly.

The principle of the washer was the forcing of the gas through water, while the scrubber aims at bringing the gas into contact with water or a wetted surface without pressure. The liquor thus produced was at first not worth much; but, to give an instance of its increase in value, about 1855, Laming (who had given a great deal of attention to this subject, and to whom the gas world is much indebted) offered the South Metropolitan Company £250 a year for their scrubber liquor. This was considered a liberal offer, and for 10 years he had the said liquor for this sum. At the expiration of the first five years its value had much increased, but considering that in the first place the company was indebted to Laming for getting anything for this liquor, his contract was renewed for a second term of five years, by which time the scrubber liquor had about doubled in value, after allowing for increase of make.

For a long time coke only was used for filling scrubbers. Hills recommended that it should have the breeze and dust separated, and that the large pieces should form the lowest layer, of, say, a few feet in thickness, then a similar layer of smaller pieces, and so on, until the last layer was composed of pieces of about the size of walnuts. This plan involved a good deal of trouble, but it was certainly better than the indiscriminate throwing in of the coke, in that it was more effective, and did not get so soon choked with tar.

The other plan (so far as I can learn) that has been longest in use was the adoption of the Goldsworthy Gurney jet—a jet of water under great pressure impinging on a small disc or button, which scatters the water as fine spray throughout the vessel, such vessel being empty, or at most having perhaps one or two tiers of perforated trays, the water thus descending in the form of rain through the gas. I am told this effectively removes the ammonia, but at some places where it is in use, on asking what the liquor fetches, the reply has been that the liquor is not saleable; which means, most probably, that by this means of scrubbing the quantity of water required to remove the ammonia is so great that the resulting liquor is too weak for sale. The water descends too rapidly, and is not, therefore, in contact with the gas for a sufficiently long time. The object in putting anything in a scrubber is simply to retard and divide the water in its passage downwards.

I now proceed to describe some of the plans at present in successful use for charging or fitting up the modern scrubber, and the various methods adopted for distributing the water or liquor.

The following may be stated as the principles to be kept in view:—

1. That the gas should travel as slowly and freely as possible, and therefore with the minimum of pressure or resistance.

2. That in its passage it should be brought into contact with the largest possible wetted surface.

3. That, in order to comply with No. 1, the scrubbing material should occupy as little as possible of the space in the scrubber.

4. That the scrubbing material should not be liable to get choked with tar and naphthaline, and, consequently, not require changing.

5. That, in order to obtain strong liquor, the water should be distributed equally all over, and in very small quantity, this being also necessary to avoid impoverishing the gas.

The most common method of filling scrubbers at the present time is with coke, as above described. The chief objection I have to make against it is not as to its effectiveness for removing ammonia, but that it gets choked with tar, &c., and must therefore be emptied and refilled. At one large London works the scrubbers are changed twice a year. In my case they will go for about two years. There is one now in use, 15 feet 6 inches diameter, and with only 40,000 feet an hour passing through it, giving between 4 inches and 5 inches pressure. The gas is thoroughly condensed, but as 500 gallons of liquor per hour have been passing through this vessel, a considerable quantity of tar has been deposited in the coke. At the City of London works, where Mr. Mann has worked his scrubbers very successfully for many years, they require changing very seldom indeed, but he passes nothing through them but water. I have one other objection to coke, and that is, that it occupies so much of the area or cubic contents of the vessel charged with it. If a vessel of 1200 cubic feet contents is filled with coke, the interstitial space is 610 feet, or, say, one-half of the whole, the relative proportions will vary to some extent with the size of the pieces, but my experiment was with the coke in its ordinary state. This rule, of course, only applies when the coke in a scrubber is quite free from tar, &c., and when in that state the gas passes slowly and freely; but when the coke becomes choked to such an extent as to show its effect on the pressure-gauge, the interstitial space must be reduced very much, when the gas must pass very quickly, while the water or liquor probably flows down two or three small channels, instead of gently working its way through the whole mass, as it does when the coke is clean. It therefore comes to this: If the gas is thoroughly condensed, and nothing but water is used, as at the City Gas-Works, coke answers the purpose admirably and lasts for an indefinite time; but if tar to any extent comes in contact with it, either from imperfect condensation or where the gas is washed with liquor, which deposits its tar in the coke, the result will be that in a longer or shorter time the coke must be changed, which is a great nuisance.

At some places brickbats are used; the remarks about coke apply equally here, the bricks probably lie closer, and therefore in this respect are inferior to coke.

Broken pottery has been tried, but did not succeed; it fills up too much of the space, and forms a succession of cups or dishes which catch and retain the tar and liquor.

Drain-pipes of different forms and sizes have also been used with success. That form and arrangement which is found most useful is now in work at the Phœnix Gas-Works at Vauxhall. Three layers of 2-inch unglazed drain-pipes are placed on each of the two trays; these pipes stand on end, and consequently offer no resistance to the passage of the gas, which is divided into a great number of small streams, while the water or liquor is spread over a large surface, and I should think there could be no risk of this arrangement becoming choked. Boulders or pebbles are also used, and I believe answer very well, though they are difficult to get in many places, are very heavy, and take up much space.

There is just one other plan, which, after much consideration of the subject, I have adopted. I believe I was the first to try it. The circumstances that led to the idea were the difficulties and nuisance attending the use of coke. Something being wanted that should present the largest possible surface with the freest passage for the gas, and after experimenting with various things, and more especially different forms of drain tiles or pipes and pottery, the arrangement of thin boards which I now exhibit was tried. A scrubber was fitted up in 1866 with them, which has been in use ever since, and to all appearances will go on continuously without risk or possibility of becoming choked. This arrangement presents a larger surface than any of the others; the material in a cubic foot occupies less space, and there can be no question about the freeness with which the gas passes, which is moreover divided into a vast number of such thin streams that with the rolling sort of motion that fluids assume, caused by friction in passing over surfaces (somewhat rough as these are), every particle of the gas must be brought into contact with the wet surface of the boards over and over again.

To fit up a scrubber on this plan, the wood required is as follows:—The boards are cut from deals or planks, 9 or 11 inches wide, 3 inches thick, and with nine deep cuts dividing them into ten thin boards about a quarter of an inch thick. The small upright blocks which are nailed between the boards to keep them a proper distance apart are 1 inch by half an inch, while to keep each tier separate from those above and below it, and to serve also for sleepers or joists, I use pieces 1½ or 2 inches square.

With this plan care must be taken to prevent the gas going up all in one place, and to attain this I fix a sort of inverted trough, made of 1½-inch boards, which covers the inlet and extends across the bottom of the scrubber; the gas escapes from this trough through a number of small apertures in its sides, and is thus distributed with sufficient uniformity.

The fitting of the boards is now proceeded with. The first tier is laid on the bottom tier of sieves which used to carry the coke, and tier above tier is fitted, until the vessel is nearly half filled; a space is then left of about 2 feet 6 inches, when another succession of tiers is laid which fill the remaining half, and on the top is placed coarse cocoa-nut matting to spread the water. I am now fitting up a scrubber 15 feet 6 inches diameter and 28 feet high; in it will be placed 22 tiers of these boards, 258 in a tier, which will expose a surface of over 128,000 square feet, or within a trifle of three acres, and at the same time in each tier of 188 cubic feet the boards occupy not more than 60 to 65 feet, thus leaving 120 feet for the passage of the gas; the boards, in fact, in the part filled by them, take up one-third of the space, leaving two-thirds for the gas.

But what is the result? My system of working is to pass the gas through three scrubbers. I happen to have four, and so use three, but find two are sufficient with this plan of fitting up. The first two are supplied with a large quantity of liquor, and the last with a small quantity of water. The greater part of the ammonia is absorbed by the liquor, which consists of that from the condenser, as well as that from the water scrubber (by this means it is increased in strength to 10 or 11 ozs.); the remaining ammonia is quite removed by the use of from 5 to 6 gallons of water in the last scrubber to the ton of coal, or hardly more than half a gallon to 1000 feet of gas; the liquor so produced being from 7 to 9 ozs. strength after passing through the wood scrubber, while the same vessel filled with coke required 3 or 4 gallons more water to the ton, and produced liquor of only 3 to 5 ozs. strength. The arrangement of thin boards is therefore about twice as good as the coke.

I have endeavoured to ascertain the average amount of surface exposed to the action of the gas when coke is used, but from its irregularities cannot arrive at it correctly, having been obliged to estimate in order to make a comparison with the surface exposed by other materials, such as drain-pipes and boards. The result, as nearly as I can make out, is as follows, the only uncertainty being in respect to the coke:—

Taking one cubic foot of the space occupied, I find

Coke gives about	8½	square feet of surface.
3-inch drain-pipes	17	" "
2-inch "	21	" "
Boards, as above described	31	" "
Coke occupies	½	the space.
3-inch drain-pipes	⅛	"
2-inch "	⅙	"
Boards	⅛	"

Distributing Apparatus: First comes the Barker's mill, which was used for a number of years with varying success, but was liable to several objections, among them the holes, being small, were often stopped up, and the machine would not revolve in consequence; then, for lightness, it was made of brass tube, which, under the action of ammonia, speedily corroded; but, supposing these defects overcome, the instrument possesses great advantages, one being that if it can be kept going it distributes the water or liquor very equally, and being self-acting all gearing or machinery is avoided. In the mill now in the room the danger of the holes stopping is avoided by making them larger, about 5-16th of an inch diameter; they are so arranged that each hole in its circle has to supply liquor to 20 square feet of surface. Corrosion is prevented by using tin pipe, which lasts three or four years, with liquor passing through it, longer with water. The mill works on a steel centre at the bottom, and at the top has a steel spindle working in a small hole in the top plate, while to see that it is at work a notch is cut in the top of this spindle, which takes hold of a corresponding projection on the end of another spindle, at the top of which is a T, which, projecting above the scrubber, and revolving with the spreader, shows whether the latter is working properly. Instead of a gland, a water-joint is used, through which the spindle works without friction. The mill will work for from three to six months without any attention. At Exeter a Barker's mill of wrought-iron pipe, with four arms, is found to answer the purpose admirably.

When water is used, the quantity being too small to turn the mill, an intermittent stream is needed, and instead of the tumbling box a square or round vessel holding seven or eight gallons is fitted with a valve at the bottom, the spindle of the valve reaching to the top. A float slides on this spindle, which rises with the water, and when at the proper height lifts a weighted bell-crank, which, in its turn, lifts the valve. As the box empties itself the float sinks, and by its weight causes the loaded bell-crank to return to its original position, thus closing the valve and shutting off the supply of water until the box is again filled.

The Gurney jet has already been mentioned. Fixed perforated arms of iron pipe require no description. They were commonly used, and are still in some places.

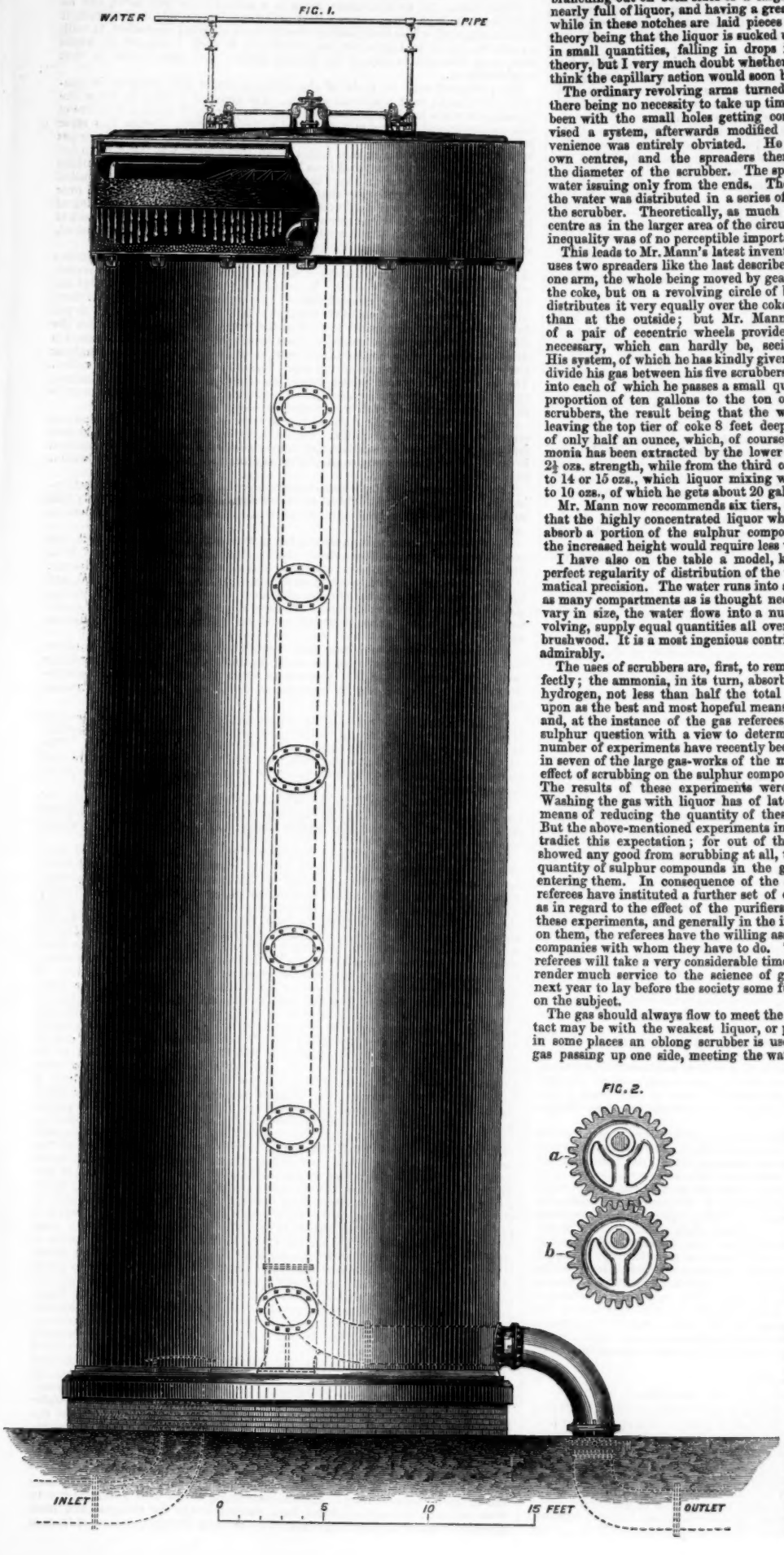


FIG. 1.

Another plan is with a series of troughs, arranged a short distance apart, and branching out on both sides of a large centre trough, such troughs being kept nearly full of liquor, and having a great number of notches cut in their edges, while in these notches are laid pieces of loose cotton or woollen material, the theory being that the liquor is sucked up by capillary attraction, and flows over in small quantities, falling in drops in the scrubber. This is a very pretty theory, but I very much doubt whether it will continue to work well. I should think the capillary action would soon be stopped with the tar.

The ordinary revolving arms turned by machinery require very little notice, there being no necessity to take up time in going into detail. The difficulty has been with the small holes getting corroded, and to avoid this Mr. Mann devised a system, afterwards modified by Mr. Trewby, by which this inconvenience was entirely obviated. He used two spreaders revolving on their own centres, and the spreaders themselves also revolving in a circle half the diameter of the scrubber. The spreaders had each two arms, the liquor or water issuing only from the ends. The result was that by this double motion the water was distributed in a series of eccentric circles over the whole area of the scrubber. Theoretically, as much was discharged in the small area of the centre as in the larger area of the circumference; but practically it appears this inequality was of no perceptible importance.

This leads to Mr. Mann's latest invention, a model of which is in the room. He uses two spreaders like the last described, but they have fixed centres, and only one arm, the whole being moved by gearing. The water falls not directly on to the coke, but on a revolving circle of brushwood, which catches the water and distributes it very equally over the coke. Somewhat more falls in the centre than at the outside; but Mr. Mann has by a very simple arrangement of a pair of eccentric wheels provided for a perfectly equal distribution if necessary, which can hardly be, seeing the success with which he works. His system, of which he has kindly given me particulars for this association, is to divide his gas between his five scrubbers, about 12 feet diameter by 28 feet high, into each of which he passes a small quantity of water. It is supplied in the proportion of ten gallons to the ton of coal, and no liquor is pumped into his scrubbers, the result being that the whole of the ammonia is removed. On leaving the top tier of coke 8 feet deep, the water has attained the strength of only half an ounce, which, of course, shows that the greater part of the ammonia has been extracted by the lower tiers, the second or middle one showing 2½ ozs. strength, while from the third or bottom one the strength has increased to 14 or 15 ozs., which liquor mixing with that condensed brings up the whole to 10 ozs., of which he gets about 20 gallons to the ton of coal.

Mr. Mann now recommends six tiers, of 8 feet each, instead of three, believing that the highly concentrated liquor which would be produced would probably absorb a portion of the sulphur compounds which give so much trouble, and the increased height would require less water to absorb the ammonia.

I have also on the table a model, kindly lent by Mr. F. C. Hills, which, if perfect regularity of distribution of the water is required, effects it with mathematical precision. The water runs into a circular revolving trough, divided into as many compartments as is thought necessary, and from these divisions, which vary in size, the water flows into a number of concentric troughs, which, revolving, supply equal quantities all over the surface of the coke or the rotating brushwood. It is a most ingenious contrivance, and would doubtless do the work admirably.

The uses of scrubbers are, first, to remove ammonia, which they will do perfectly; the ammonia, in its turn, absorbs a very large quantity of sulphuretted hydrogen, not less than half the total quantity. They have also been looked upon as the best and most hopeful means of reducing the sulphur compounds, and, at the instance of the gas referees, who are engaged in investigating the sulphur question with a view to determine a maximum for this impurity, a number of experiments have recently been made, according to their instructions, in seven of the large gas-works of the metropolis, with a view to ascertain the effect of scrubbing on the sulphur compounds other than sulphuretted hydrogen. The results of these experiments were most unexpected and extraordinary. Washing the gas with liquor has of late been looked to as the most hopeful means of reducing the quantity of these troublesome compounds of sulphur. But the above-mentioned experiments instituted by the referees appear to contradict this expectation; for out of the seven sets of experiments only two showed any good from scrubbing at all, the remaining five showing a greater quantity of sulphur compounds in the gas on leaving the scrubbers than on entering them. In consequence of the startling character of these results, the referees have instituted a further set of experiments of the same kind, as well as in regard to the effect of the purifiers, whether lime or oxide of iron. In these experiments, and generally in the important investigations which devolve on them, the referees have the willing assistance of the engineers of the various companies with whom they have to do. The experiments now instituted by the referees will take a very considerable time to execute, but they are calculated to render much service to the science of gas manufacture, and I hope to be able next year to lay before the society some further and more definite information on the subject.

The gas should always flow to meet the water or liquor, so that its last contact may be with the weakest liquor, or pure water. I mention this, because in some places an oblong scrubber is used with a division in the centre, the gas passing up one side, meeting the water, and down the other, thus travelling with it. This half of the scrubber, when worked in this manner, is worse than useless.

FIG. 2.

As to the power of water to absorb ammonia, Dr. Odling, in this room, two years ago, showed, by a beautiful experiment, that pure ammonia gas was instantly absorbed, but when mixed with only 25 per cent. of another gas or air, a very long time elapsed before the absorption took place.

My excuse for reading so long a paper is the desire to give as much information as possible.

Mr. GODDARD thanked Mr. Livesey for the very practical paper just read. He stated that he once tried brushwood in his scrubbers, but found that the blocking up by tar rendered the pressure so great that it had to be removed; and now for some years he had been using boulder stones, which proved better than any other material. He employed coke for a considerable period, but the same objection to it which Mr. Livesey pointed out was realized by him. The boulders he used were of various sizes according to their position in the scrubber, and they presented less obstruction to the passage of the gas than anything else.

Mr. DOUGLAS (Newcastle) said he obtained 30 gallons of 10-oz. liquor

per ton of coals. He employed new bricks, and filled the scrubbers up with them, pumping a large quantity of liquor through and using no water. Formerly he ran the refuse liquor from the ammonia-works into the river, but, that being a nuisance, he now pumped it in bulk into the scrubbers a second time instead of using clean water. It was worked over and over again, and the results he obtained were highly satisfactory.

Mr. CRAVEN said he had a large scrubber, with four divisions, at each of his works. The three first divisions were empty, and were supplied, through a Gurney's jet, with the ammoniacal liquor, which was pumped up again and again for use in the scrubber. He was thus able to increase the strength from 8 to 16 ozs. The last of the divisions was filled with wings, or brushwood, which was found to answer very well, and presented so little obstruction, that, after twelve months use, the pressure was not increased more than half an inch.

Mr. WARNER said he endorsed all that Mr. Livesey had written, but he claimed to divide honours with him in the construction of the kind of scrubber described in the paper. It was about the same time that Mr. Livesey spoke of that he (Mr. Warner) constructed a large scrubber on a similar principle, but his boards were arranged differently. He found from experience that if, instead of placing them vertically, they were placed obliquely one to another, the water or ammoniacal liquor did a much larger amount of work than otherwise. He produced a model of his arrangement, which he stated he had sent to London twelve months ago. There was no complex arrangement on the top of his scrubber for effecting the distribution, but, by a simple arrangement of troughs, the water flowed down from board to board throughout the whole series. In looking through the tiers of trays it would be seen that there was quite a shower as of rain, and, if placed at their proper angle, the water trickled down both sides, so that both surfaces of the boards were entirely wetted. By this plan no spreader was required, but it was found that complete distribution of the water or liquor was effected. He had had such a scrubber in use since 1866, and it had worked satisfactorily ever since. The year before last he erected another, which was 16 feet square and about 18 feet high, with an overflow-trough on the top, and he found that a very small quantity of water did a large quantity of work. Both vessels were divided into four compartments.

Mr. UPWARD, referring to the question of an increased quantity of sulphur being found upon the outlet of the scrubber, said he thought it might be attributed to the coke employed, and therefore, in a scrubber formed as Mr. Livesey had shown, in all probability this difficulty would be removed. Some little time ago he made experiments with a scrubber, using only water and coke, and he found the same result as Mr. Livesey had described—an additional quantity of sulphur compounds upon the outlet.

Mr. HARRIS (Great Central Gas-Works) said there was no doubt as to the efficiency of the scrubber described, for removing ammonia. At his works, some twelve years ago, a patent was put into operation by Mr. Laming for the purpose of purifying gas by the use of ammonia. His system was to purify the ammonia as Mr. Hills proposed, by means of oxide of iron, and then to take the pure caustic ammonia and wash the gas with it. That process was carried on for some time, but it never thoroughly succeeded, though it would be successful possibly for half an hour at a time. The difficulty appeared to be to bring the caustic ammonia sufficiently in contact with the gas. Since then various improvements had been made in the water-distributing apparatus, and doubtless the system of Mr. Hills stood a better chance of success now on that account. There was not the slightest question that ammonia would act as a perfect purifier for gas if in the first instance it was itself purified and then brought in contact with the impure gas. The scrubbers, having failed for the purpose intended, had since been used as ordinary scrubbers. He did not succeed in taking out the whole of the ammonia from his gas; but recent experiments showed that the quantity was reduced to 1 or 2 grains per 100 cubic feet. He had four scrubbers in operation, and the crude gas entering the first passed in succession through the whole of them. The last was supplied with 10 gallons of water to the ton of coals, and this water found its way through the entire series. Formerly coke was employed as the scrubbing material, but it was found that the superstratum of coke so broke the lower portions that the gas would not pass through. He now placed half bricks at the bottom of the scrubbers, and gradually reduced the size of the bats till at the top they were about the size of eggs. Scrubbers thus worked were very efficient, and did not require any cleaning out more than once in two years—not until it was found that there was a very large amount of pressure. With respect to the removal of the sulphur compounds from gas, Mr. Livesey spoke of several experiments made in London, in which it was found that there was more sulphur at the outlet than at the inlet of the scrubbers. His (Mr. Harris's) case was a most notable instance of the kind, for upon the average of a month's working the sulphur increased to the extent of 4 grains. He thought possibly this might arise from the ammoniacal liquor giving off some sulphur compounds to the gas. He then adopted the system of simply washing with water, previously having used partly water and partly liquor, but this did not make any appreciable difference in the amount of sulphur at the extreme end. The experiments were now under consideration, and he doubted not that, with the attention which the engineers of London were paying to the subject, during the next twelve months some very important facts would be elicited as to the presence of sulphur compounds in gas.

Mr. UPWARD said that Laming's process of purifying liquor was a different thing to that which he had spoken of. The purified liquor as described in his paper was entirely free from carbonic acid as well as sulphuretted hydrogen. This could not be effected by the use of oxide of iron simply, and the importance of getting rid of the carbonic acid would be seen at once when it was remembered that 1 per cent. of that impurity in gas would lower its illuminating power by 2 candles.

Mr. LIVESEY, in reply, said Mr. Warner's idea of constructing a scrubber had occurred to him, but he gave it up for this reason, that he thought the gas would strike on the under surfaces of the boards, whereas the greater portion of the water would run down on the upper surfaces. This, however, appeared to be only a theoretical objection, as Mr. Warner said his plan answered very well. Mr. Warner spoke of producing a copious shower in the purifier; the difficulty seemed to be to distribute a small quantity. With a copious shower there was something more valuable washed out of the gas than ammonia. As to the remarks about Mr. Laming's process, he felt that a great deal of credit was due to that gentleman, who was the first to put forward the idea that liquor purified from its sulphuretted hydrogen would purify the gas. He (Mr. Livesey) made an unsuccessful attempt in the same direction, but Mr. Hills had been fortunate in bringing the process into practical working. The only point at which a failure might take place was that it might take too much heat to boil off the carbonic acid and sulphuretted hydrogen; but Mr. Hills seemed to have taken the best possible means to save the heat in the apparatus erected at the South Metropolitan Gas-Works. It was also necessary to provide against the loss of ammonia by this process.

Mr. METHVEN read the following paper:—

ON THE MANUFACTURE OF TAR PAVEMENT.

In most provincial towns there are two important bodies of men, the Paving Commissioners and the gas directors. The one is pledged to keep the rates low, and the other to keep the price of gas as low as will enable them to provide the statutory dividend. As one means of ensuring a cheap supply of gas is to create a greater demand and obtain a better price for the residual products, I have great pleasure in introducing a subject the adoption of which would be advantageous to both of these bodies. It is not a new one, but has hitherto been a neglected source of revenue to gas companies, and will also be a great benefit to the public. That subject is tar pavement. In some counties, such as Yorkshire, where stone is as abundant as brain is said to be, tar pavement will receive but little attention; but in the eastern and some other counties, where the same conditions do not exist, but where York flag costs 7s. per yard laid, tar pavement is a desideratum. In such districts there is a scramble for pavement, and on account of the high price, unless a Paving Commissioner reside in the street, it remains unpaved. The foot-passenger has thus, to his great discomfort, to walk on gravel, or, as in Colchester, on stones laid in such a manner as would have done discredit to any of the Roman paviors who once resided in that neighbourhood.

Tar pavement may be made of the ordinary cinder-dirt produced in gas-works, of shingle, or of a mixture of both. The material is burnt in heaps like ballast, and when hot is mixed with hot tar. In practice, I make a small fire of coke on the ground, and cover it with cinder-dirt or shingle. When this layer is hot another is added, and so on in succession until a heap large enough has been provided. The tar is now boiled in an iron copper, and taken when hot and mixed with the hot material from the heap already described, in quantities of two bushels at a time, in about the proportion of one gallon to every bushel of cinder-dirt, and slightly less than a gallon for the gravel. It is turned over and over with the shovel until every part of the material has got a covering of tar. Then I pass the whole through a sieve with a $\frac{3}{4}$-inch mesh, and part of it through another with $\frac{1}{4}$-inch mesh, and put the whole in heaps until required, as it may be kept for months before being laid down.

Before the pavement is laid, an edging should be provided about 2 inches thick, and projecting 2 inches above the surface of the ground to be covered, which should be tolerably even. It is advisable to have the ground next the kerb well trodden on or rammed before the pavement is laid, otherwise there will be an unseemly hollow next the kerb. In laying, the rough stuff is put down first and rolled tolerably firm, then the second quality is put on, then the third, and when the whole has been raked level a little of the finest material is sifted on through a sieve with $\frac{1}{2}$-inch meshes, and a little fine white shingle or Derbyshire spar is sprinkled on the top. The whole must now be well rolled. The best roller is a water ballast roller, which at first is used without ballast, and well wetted to prevent adhesion of the material, and when the pavement is slightly consolidated the full weight should be applied.

For heavy cart traffic the material should be made of shingle only, heated and mixed as above, and well rolled. Both descriptions of pavement are laid best and most easily in warm weather, and should be rolled when the sun has warmed it well. Those parts in angles should be well rammed, and trimmed off with a light shovel.

Though apparently a simple manufacture, there is a little difficulty in ascertaining the proportion of tar to gravel or cinder-dirt. A little experience only will be necessary, in this as well as in all other manufactures, to enable any one to carry it out successfully.

I cannot recommend this pavement too much, as it is cheap, wears well, and can be easily repaired. The colour, which never can be made to equal York flag, and the smell for some time after it is laid, are the only objections to its use. It can be laid with a good profit in any district at 1s. 4d. per square yard, and besides being a boon to the public, who must otherwise walk on gravel, is a great advantage to gas companies. To them it provides a remunerative outlet for their tar, which often otherwise must be sold at a low price to distant distillers.

Since writing the above I have seen a paragraph in the *Times*, which states that it is proposed to pave the streets of London with stone laid in asphalte instead of lime grout. This is just a more systematic application of the above-described plan; for the tar, by being boiled and thrown on hot stones, becomes an elastic asphalte.

Mr. LIVESEY said he was glad the subject had been brought forward, because it was one upon which they all wanted information. At his own place they had been trying for years to get a good tar pavement, and had never succeeded. The paper just read described so clearly what was the right way to do it, that he and many others would now be able to make their attempt with some hope of accomplishing it.

Mr. IRONS (Gosport) said in the public works at Portsmouth some miles of tar pavement had been laid. It was found to be very cheap, and to answer remarkably well. The material used in London was the Seyssel asphalte, which was rather better than tar.

Mr. ANDERSON thought those members of the association who visited Nottingham two or three years ago could not fail to remember that a large proportion of the pavements of the town were of this description. He was so pleased with what he saw there that he determined to try the experiment at Dover, where there was a considerable amount of paving to do in connexion with the gas-works. He wrote to Nottingham, and, through the kindness of Mr. Loam, obtained the services of a man who had a thorough experience in this kind of work. The matter was put into his hands entirely, and he made both foot-paving and cart-road over the whole of the works, which was so satisfactory that he was persuaded it would never be given up. He then went further. A good many people resorted to Dover for the benefit of their health. The town had been paved with small pebbles, and he frequently called the attention of the authorities to what had been done at the gas-works, and asked permission to lay down some of this paving in a public thoroughfare, where a new church had been erected. Having obtained leave, the same man was employed, and so satisfactory was the result that next year the same person was engaged to do nearly the whole of the paving of the side paths that had not hitherto been paved, and, so far as he could judge, it was perfectly satisfactory. It was a capital paving, and a paving that justified each one of them in their several localities to take some trouble in introducing. It was very difficult to get public bodies to move, but by incessant application they could overcome their inertia. For cart-road paving this system was equally applicable. In making an experiment of this kind they should insist upon having a concrete foundation at the beginning. The history of all good road-making depended upon a good foundation. They might make a road as good as they liked at the surface, but if the substratum was apt to yield, the chances were hollows would be formed, water would get in, and when the frost came it would expand the water and destroy the road. The best system in the world might be condemned through want of proper appliances in the execution of it. The Seyssel asphalte was a very extraordinary substance. The streets of Paris had been for a great number of years largely paved with that substance, and in January last he saw them doing it on what appeared to be a perfectly novel plan. Formerly they used to put it on in a liquid form, but now they had discovered that the same matter ground into fine powder, and heated to such a heat as could be well borne in the hand, put down in the shape of that dry powder in the warm state and rolled, became in a couple of hours so hard that carriages could pass over it. All these pavements were, in his opinion, far superior to stone, even if they got stone cheaper. They were agreeable to walk upon. In very warm weather they would yield a little, but if properly executed they did not melt sufficiently to form marks that the next foot-mark did not obliterate. No harm was done to the pavement when a good solid foundation was given. One agreeable feature in the pavement was that it dried almost immediately after a shower of rain. The water ran off, and as soon as ever the atmosphere became of a dry character the pavement was quite dry. This was a matter each should take up in his own locality, because it was not only a great convenience to the town, but was a mode of disposing of a waste product which was not always profitable.

Mr. CHURCH said Mr. Methven recommended tar paving as being more economical than stone. No evidence was before them in support of the statement, and he doubted its accuracy. He had something to do with public bodies in these matters, and always found York pavement was the cheapest and most durable pavement that could be used. There was an immense amount of friction

on pavement generally, and even with York pavement it was astonishing how soon it wore. Then the appearance of the tar pavement was very objectionable. A town covered with tar pavement presented a most sombre and unpleasant appearance. He did not think people who lived in towns paved in that manner could be at all of a sanguine temperament. Another objection was the difficulty of repairing it. What with the frequent necessity for putting in gas services, and the execution of sanitary works, laying water-pipes and telegraph wires, the pavements of towns were constantly being ripped up; and if composed of tar they would be more difficult to repair and relay than stone. As persons connected with gas-works frequently disturbed the roads, the economy of the question was of some importance to them. He had seen bricks tried of various kinds, but in the end always found that such pavement wore out in one-third of the time of stone. Seyssel asphalte was remarkable stuff, but it was quite as dear as stone. This was the only kind of asphalte to be depended upon, for inferior descriptions were liable to expansion and contraction, which, of course, was most prejudicial to its endurance, and duration must be considered as well as first cost.

The PRESIDENT asked whether Mr. Church could give any particulars of the duration of the different pavements, stones and tar.

Mr. CHURCH said ordinary stone pavement lasted about ten years—*i. e.*, it required taking up and dressing, and could then be relaid. Bricks would last about half that time. He believed asphalte was fully equal to stone. A very good specimen of asphalte was that laid down on the French system near the Bank of England, and certainly so far as it had gone it was a success. There was a difficulty lately with the telegraph company. They had to carry their lines of telegraph there, and they were trying, as far as they could, to get out of the road, because of the difficulty in repairing it. There was an amount of skilled labour required in this matter, which was not always to be had.

Mr. DUNNING said for some years he had the surveyorship of the town of Middlesborough, where tar pavement had been employed, and he could give some information as to the results. The cost of flagging with Yorkshire stone had been from 4s. 8d. to 5s. a superficial yard. The cost of Staffordshire bricks was 3s. 6d. The cost of the tar pavement, which had been made very much in the same way as described by Mr. Anderson, was 1s. Those were prices that had been in vogue for the last 15 years. He laid down tar pavement in one locality ten years ago, and to all appearance it was as good now as the first year it was laid down, with this slight exception—it was an elevated footpath supported by a low retaining wall of brick, and that had given a little, so that a channel had formed just inside the kerbstone. The whole of the rest of the asphalte was as good as it was the first day it was laid down. They had not experienced any difficulty about the pipes. It certainly required very great care on the part of the men in repairing it, but if they were careful the repair was quite equal to that of flags or bricks, because, in nine cases out of ten, in taking up and laying down flags they were chipped, and they seldom got the same good joint with flag and brick that they did with asphalte. With regard to telegraph wires there could be no difficulty, because those wires might be laid under the kerbstone, which could be supported by brickwork on both sides. The 1s. a yard left a very good profit, so it was evidently to their advantage to encourage the making of the tar pavement

Mr. MEAD (Reigate) said in the south of England, where York flags cost 9s. per square yard, tar paving presented many advantages. He had himself introduced it with great success. It was economically constructed. It was inexpensive in maintenance, and where formerly there was a miserable, muddy path, he had now a sound paving which was dry in ten minutes after rain.

Mr. JONES said the tar pavement at Dover cost 10d. per yard, which price included the carriage of material from the beach to the works, and from thence to the place where it was laid down. If the materials could be procured on the spot the cost would not exceed 6d. or 8d. per yard. The piece Mr. Anderson referred to was laid three years ago, and was quite as good as it was when first put down. A practical stonemason in the town said he was perfectly satisfied that tar pavement would last very much longer than flagging. It was always desirable slightly to distil the tar so at to take off the oil, otherwise it would not have the cohesive property which was necessary.

Mr. BROADHEAD said tar pavement had been laid down in Grimsby at 13½d. per yard, while flagging cost 4s. 6d. They were now laying down a considerable quantity of tar pavement. It was prepared in the following way:—The contractor got the gravel from the coast, sifted it, and took out the rough gravel; that was put into crude tar. He then went to the gas-works and the factories of the town and got all their ashes; these were put through a fine sieve, then put into ovens, and afterwards mixed with the crude tar. He picked the footpaths (kerbed with 4-inch kerbs) up about 2 inches deep, laid on the rough gravel that has been already in tar, rolled it, and then put on the fine ashes that had been saturated with tar. This was rolled down, and was then sprinkled with Derbyshire spar. He himself laid down a tar pavement round the gas-works eight or ten years ago, which, though somewhat rough now, had been very satisfactory. There was no difficulty in relaying such paving after it had been broken up for gas or water services, and in a day or two afterwards there was no visible marks of the paving having been removed.

Mr. LIVESAY (Ventnor) said, as town surveyor, he was very well acquainted with the Pyrimont asphalte which had been referred to. He thought tar was a valuable material for pavement, but its success would depend very much upon the manner in which it was mixed and laid. The nearer its condition was assimilated to that of asphalte, the greater satisfaction would result from its use. The Seyssel asphalte was composed of limestone from the Jura Mountains, which was thoroughly impregnated with mineral tar. It was brought to this country, ground down and melted, and grit mixed with it. If grit or sand were introduced into the tar pavement along with shingle, it would render it much more binding in character. The asphalte paving in Trafalgar Square had proved very successful, and the wear was almost imperceptible. If managers and engineers of gas-works were to study that material a little more, and the mode of obtaining and using it, the experience so gained would be of great advantage in introducing tar pavement, which he should like to see adopted universally.

Mr. ANDERSON said they were favoured with the presence of M. Ellissen, of the Paris Gas-Works, who wished him to say a few words in more detailed explanation of what had been stated respecting Paris asphalte; but before doing so he desired to make a remark in reference to what had fallen from Mr. Church. Mr. Church fancied that people who could admire dark pavement must be of a sombre disposition. He joined issue on that proposition, for it appeared to him that the man who could not enjoy the sombre aspect of the pavement must be too sombre, and that the man who could had more elasticity in his nature than the man who could not. But it was not necessary that the paving should have this sombre character. He had seen it beautifully granitified, if he might so say, on the top, by fine particles of Derbyshire spar, and whether sombre or not, when it had the spar upon it it was a sparkling pavement, far superior to anything to be got in the way of stone. Passing from that, M. Ellissen wished it to be stated that the asphalte in the streets of Paris was not the pure asphalte which was put down on the foot-pavements, but the whole of the limestone with the asphalte combined was ground up into a fine powder and distributed in the way mentioned, and, instead of being rolled, was stamped with warm stampers. It was heated to 107° Cent. He was also informed that the material naturally had about 15 per cent. of tar in it.

Mr. METHVEN, in reply, said cart-roads could be made by using large stones only, about the size of walnuts, without any intermixture of cinder-dust at all. Sometimes they might fail in mixing it, but it was a matter of experience as to the right method of proceeding. He had a road laid for two or three years with this tar pavement, over which he had carted between 4000 and 5000 tons a year, and it stood very well. Wherever there were gas-works they could make a very good foot-pavement merely with the breeze, simply heating it and mixing it with tar. That did not always answer when there was a hot exposure, but some shingle mixed with it would make it hard. Mr. Church had referred to the want of evidence as to its durability, but after what the speakers had said he must be satisfied on that point. As to the question of repairing, this was very easily done. They only wanted the stuff, and then any labourer could do it. If it was left a little higher than the old pavement, so that allowance was made for the settlement of the material, in a short time they would not be able to discover the joint. There was no difficulty in mending it, because the stuff could be kept on the work for months without receiving any injury. When laid, if sprinkled with spar or light gravel, its appearance was much improved.

THE INTERNATIONAL EXHIBITION, 1871.

Mr. P. LE NEVE FOSTER (Secretary to the Society of Arts): Gentlemen, having the permission of your chairman to interrupt your proceedings at the present stage, I will as briefly as possible state the object I am desirous to bring before you. Her Majesty's Commissioners for the International Exhibition which is to take place in 1871 were anxious that I should bring before this meeting, composed as it is of gentlemen from all parts of the kingdom, and connected with a large and important branch of manufacture, the nature of that exhibition, in the hope that they may have your aid, assistance, and co-operation in making it as successful as possible. I dare say you have heard that there is to be a series of exhibitions of an international character, the first of which will take place next year. These exhibitions will embrace various manufactures arranged in sections. That of next year will consist of six divisions, one of which embraces the fine arts, the others certain classes of manufacture—viz., pottery, woollen and worsted fabrics, educational works, and appliances. But under the division of manufacture, which includes machinery and raw materials, there is a division for scientific inventions and new discoveries of all kinds, and it was hoped that, by making this announcement, some gentlemen connected with the British Association of Gas Managers might be induced to bring forward, at that exhibition, some of the various interesting inventions which we know are continually being made in gas manufacture.

Mr. WARNER (South Shields) presented the following paper, which, owing to the limited time at the disposal of the association, was only partly read.

Mr. W. J. WARNER read the following paper:—

ON GAS-METERS.

The talented writer of the "History of the Gas-Meter," published upwards of twenty years since in the JOURNAL OF GAS LIGHTING, has divided the instruments into three classes—wet, dry, and inferential.

The latter class may be fairly represented by the article patented in 1824 by a very notable character in his day—Sir William Congreve. He proposed "to measure and register the flow of gas (I quote his specification) through a pipe or cock, *when the pressure is uniform*, by registering the length of time the pipe or cock is open. For this purpose there is applied to each cock or pipe a small clock movement, which will be started by the opening of the cock, and stopped again by closing it. The dial attached will indicate any number of hours the clock may have gone." From Richards's edition of "Hughes on Gas Lighting" it will be seen that this instrument was much used at one time in France. Though the arrangement is to be applied "*when the pressure is uniform*," nothing is devised to ensure the same. But four years previous (1820), Malam was a patentee of a meter which met this want. It was essentially a dry governor, consisting of an oblong plate, with leather sides and a conical valve, for regulating the pressure; and at the same time the speed of the clock was adjusted by it being made to go faster or slower according to the depression or elevation of the plate, and so of the quantity of gas passing. The regulation and adjustment, however, were not according to the consumption only, but to the initial pressure, and hence the subsequent labours and patents of Clegg upon this principle. A modification of the principle was patented, too, by Clegg in 1848, though it had been previously patented by Edge in 1842. It is "the measurement of a *fractional* part of the volume of gas only, and is effected by regulating the ingress-*valves*, so that a small valve leading to a meter will always in size bear a relative proportion to that of the valve for the general passage of the gas." In 1857 another idea was patented. A vessel is to be partially filled with a liquid with which the gas is to be saturated, and from the upper part of the vessel are to be suspended a number of strings or threads of fibrous material which by capillary action are to draw up a quantity of the liquid, and so present an extensive evaporating surface to the action of the gas in its passage through the vessel, the gas thus carries off a certain quantity of the liquid; so that by weighing or measuring what remains the amount of gas passed through may be ascertained.

As in the meter proper, however, we are indebted to the ingenious and indefatigable Clegg, so in the order of merit his inferential meter of 1830 stands pre-eminently first. Though we can but say it is a very beautiful philosophical toy, yet doubtless much time, and money, and ingenuity, were spent upon it. The principal is that known as the *pulse glasses*. There is one upon the table. It consists of two small glass globes, connected together by a small rod working upon centres, and contains alcohol. In action, two currents of gas are directed against these globes, one is heated by a small flame and directed against the lower glass, from which, by vaporization, the alcohol passes to the upper glass, in which it is again condensed by the current of cool gas being directed against it; the balance is thus disturbed—the heavy glass now takes the place of the first, and so causes a pulsation; the alcohol is again vaporized, and then condensed, and so the action is continued. You will here note that there is no positive measurement effected by any of these contrivances. This last arrangement of Clegg's may be more properly termed a differential thermometric gauge than a meter. Indeed, none of them should be so classified; there is no actual measurement—no measurement of volume.

In 1820 a small pamphlet was published by Mr. Clegg giving an account of his inventions. He says: "In 1813 I undertook the direction of the different works belonging to the Chartered Gaslight Company in London and Westminster, and during the *four* following years lighted a great part of both these cities. In the course of *that period* I invented and adopted the rotative retorts, the semi-fluid lime machine, the *rotative and reciprocating gas-meters*, the governor or regulator, and an apparatus for the decomposition of oil, tar, &c., and in 1817 I invented the collapsing gasholder." Mr. Clegg, jun., writes, in "A Brief Historical Sketch of the Introduction of Lighting by Coal Gas," "The gas-works at Peter Street, Westminster, were commenced under the direction of Mr. Clegg, in 1813. The ground upon which they were erected was a swamp, nearly on a level with the Thames, and formerly overflowed by the river. It was impossible to sink for a tank, and an iron one would then have been very expensive. This gave occasion for the construction of a *revolving gasholder*, which worked with greater regularity and less friction than any other." Now, it is somewhat surprising that this holder is not mentioned in the pamphlet that has been quoted, especially as it apparently overcame, in a very bold, ingenious, and admirable manner, a considerable difficulty.

It was, too, but the year before the publication of this pamphlet (1819) that Accum, in his "Coal Gas," gave an elaborate and minute description of the machine, and illustrated it by two engravings, one of which is on the title-page. It is this machine, I believe, that suggested the gas-meter; between them there is a strong analogy; but between the meter and the archimedian screw for raising water, as supposed by the author of the "History of the Gas-Meter," or the analogy, as is justly observed by the editor of "Clegg," "seems so faint as scarcely to be capable of suggesting such an application." In one case we have a cylinder with its axis at an angle to the horizon, and several pipes coiled around it for raising water; in the other, an annular vessel with its axis horizontal and hollow for the passage of gas into the vessel from a stuffing-box, the inlet and outlet being from the two ends of the shaft. The same description answers for the meter, only it has two chambers instead of

one, and the necessary arrangement for opening and closing the communications between them; moreover the revolving gasholder was used as a meter, a pointer and dial being attached. "In fact, this machine" (the improved gas-meter), Accum says, "performs the office of three *revolving gasholders*." A Mr. Matthews, in "An Historical Sketch of the Origin and Progress of Gas Lighting," also, and indeed more clearly and decidedly expresses the same opinion. "Mr. Clegg," he says, "had previously devised and constructed a gasholder in the form of that portion of a circle which makes 250°, and which moved vertically upon a horizontal axis, and acted upon the principle of the hydraulic bellows. As the circle was accurately graduated to indicate the quantity of gas entering in or passing from the machine, *probably it was this circumstance that suggested to Mr. Clegg the original idea of his gas-meter*." Further, Peckstone says, the four chambers of the meter "are a *range of gasholders* acting with a rotary motion instead of a vertical one."

Now, as to the other side—the archimedian theory. It is probable it arose from this same writer, Peckstone. He says, "Mr. Malam suggested to me the idea of making a gas-meter on the principle of Archimedes screw; indeed, he made a small one on that plan in the beginning of the year 1816, having the L-shaped pipe of supply and receiving-chamber."

This "L-shaped pipe and receiving-chamber" are the spout and hollow cover of the drum, and distinctly mark the second stage of the invention of the gas-meter. This *improvement*, as some have called it, bears about the same relation to the meter as the inventions of James Watt do to the condensing engine—each becomes essentially a part of the whole, and without them the machines, for the work required of them, are practically useless. Men so gifted as Clegg and Malam, and running so closely in an arduous race along an undefined course, could not fail to make warm and zealous partizans, who claimed for each what belonged to both. Peckstone was one of them. As late as 1841 he writes: "As to our holding up Mr. Malam as the *inventor* of the gas-meter in preference to Mr. Clegg, we do so under the most perfect conviction that we are correct." However, he adds, "We have no hesitation in admitting that Mr. Clegg was the first person who patented a machine with a rotary motion intended to measure gas; but at the same time we as strenuously assert that no useful instrument for that purpose was made known till April, 1817, when Mr. Malam exhibited one in action at the Westminster Gas-Works."

In contradistinction to this we can find in vol. xxxvii. (1820) of the "Transactions of the Society of Arts and Sciences," the following report:—"Mr. Malam's gas-meter *is* constructed upon the same general principles, but with such improvements as induced the society to confer a high honorary reward (the Isis gold medal); but whether the machine, in their opinion so improved, is completely open to public use *before the expiry* of Mr. Clegg's patent, the society does not presume to determine." I should think not. It was, however, settled, and in the Court of King's Bench, too (*Crosley v. Beverley*, 1829). "The patent sustained as the new apparatus contained the *essence* of the patented meter—THAT OF A DIVIDED WHEEL REVOLVING BELOW WATER."

In the examination of *any* meter it will be found to consist of three separate, distinct, and essential parts—MEASURE, VALVE, and INDEX. In the first wet, as in the ordinary dry meter, this is obvious to almost the uninitiated; there are the little gasholder or diaphragm, and the valves for opening and closing the passages between these measures and the unmeasured and measured gas; in other words, for turning the gas on into the measures for measurement, turning it off when full, and then turning the gas on again that has been measured to the burners. This is also obvious in Clegg's first rotary meter, in which the inlet-*pipes* are alternately filled and emptied of water. It is not so obvious in the present wet meter, however, though the effect is the same by the quarters or hoods entering into and rising from the water as the wheel rotates. And so of the index there are a few modifications that may be noticed, but the work is alike essentially the same in all—to keep a record of the number of measures of gas passed through the instrument, though it has been used, as it were, for the adjustment of the registration of the meter; but this is simply adapting the index to the meter instead of the meter to the index, as is usual.

In both of Clegg's rotary meters, as in the reciprocating one, the measures are *perfect* in principle; both by the rising of the gasholder and the rotation of the wheel a positive, determinate, and invariable quantity is measured at each complete action of the machine. As the *cubical capacity* of the space passed through is always the same, the displacement must be invariable, and hence the measure invariable too. This is obvious in the case of the gasholder—the only variation that can take place is in the water-line, which cannot affect the measurement; the space passed through by the top of the holder being always the same, the displacement must be the same. So, the wheel being *annular* and the water-line below the axis, the capacity of the annular cannot be affected, all the sides being of metal and rigid—hence we have a perfect measure. The complicated valvular arrangement was so defective notwithstanding, that the measure had to be modified. The spout and cover were introduced, and so the water-line had to be raised above the axis; but the principle was not altered, the spout being placed in the concentric space; it, however, could now be reduced in size, which was done, a 4-light meter, as per Peckstone, being reduced from 30 inches diameter and 8 inches deep to 12 inches diameter and 6 inches deep. "But, notwithstanding its superiority," the same writer says, "over the patent (Clegg's) gasmater, the inventor (Malam) felt desirous of making a meter which would occupy even *less* room than it did." This idea was carried out; the inside cylinder was removed, and the principle of the measure was thus altered from an invariable annular to a variable wheel, with but *five* out of the six sides being rigid, the other being formed by the ever-varying surface of the water. The L-shaped pipe or spout was placed in its present position, external to the wheel, and the hollow cover placed over it. Thus it has been continued up to the present time, notwithstanding many attempts at improvement. The most original was that of Clegg himself. In 1858 he returned to the annular principle, but the internal cylinder was made proportionately larger, and converted into a float (but this was patented in 1848), and the measures or chambers were placed eccentrically around. The idea of flotation of gas-measures does not belong to Clegg, though his object was to lessen the friction of the wheel as well as Malam's, to maintain the correctness of measure. The friction, however, by an examination of the shaft of his drum on the table, does not appear to be lessened; and I may add that if the bearings of an ordinary wet meter be examined, it will be seen that the wear is not from the weight of the wheel, but from the pressure of the gas, the upper parts of the bearings being the portions worn. Malam patented the float in connexion with a very ingenious modification of the wheel; he turned the cylinder on end, placed one end of the shaft in a step, and attached the other end to a crank, by which he obtained a circular undulating movement, as it were, similar to a dry meter re-patented by Remington and Berry in 1852, or like a colour-top or teetotum when nearly spent. These same patentees also claimed the placing of a wheel at an angle with the horizon, and rotating obliquely, a rotatory valve being attached. Smith, in 1845, also modified the wheel; he placed a small box or chamber in the centre of the wheel, and attached the partitions to it, and for the same purpose, to prevent gas passing when tilted. The Messrs. Braddock make another somewhat similar, one of which is on the table, but not with the same object, theirs being to lessen the variation in measurement. Mr. Smith also carried the partitions down to the axis in the ordinary form of wheel. Richards's wheel, patented 1858, is a simple modification by which the ordinary wheel is made to approach the annular form, and so lessen as much as possible the variation of capacity by the alteration of water-line. The sides are placed very close together at the shaft, and in a section parallel with the shaft the chambers are triangular in shape. It is rather strange that Richards should have allowed the error of Hughes to have continued. The same clever inventor also, in the name of Mr. Newton, patented, in 1859, other modifications of the wheel; the annular drum was adapted with diagonal passages and lips to the internal cylinder for the passage of water.

Again, in 1860, a Mr. Sim applied for a patent for a drum with solid central disc and plates diverging angularly, also one with an internal cylinder. Mr. Kromschroeder patented a combination of Clegg's eccentric meter with *five* chambers; and again in 1862 he patented an annular drum and float, with inlet passages through the cylinder, and outlets through the rim. The real archimedian-screw meter cropped out in 1865. Mr. Brooman patented an internal drum carrying a central perforated tube and spiral valve. Again, in the same year, Mr. Webster patented a drum with fans, the blades of which are helical or in screw form around the centre drum, nearly identical with the previous one. The original reciprocating meter of Clegg has been patented again and again, the ordinary gasholder being such an exceedingly suggestive machine, and *apparently* so simple, which indeed it is in itself as a measure, any tin pot answering the purpose, but it is the complication of parts—guides, connecting-rods, valves, &c.—that places it far below, incomparably below the ordinary wet meter.

At the commencement of a business so original as gas-making, there could not be otherwise than much attention given to so important a part of the apparatus as that for storing the gas. So we find many patents recorded for schemes of improvement, and as might be supposed those of Clegg and Malam. That of the former is the only one to which I have to refer; it bears date 1818, and the title is "An Improved Gasometer or Gasholder." It is not at all improbable that the idea for this was taken from what it is said in the specification to resemble—"a portfolio or letter-case" with its edges in a shallow tray of water. It had two sides, and two ends meeting together at top in ridge, like the roof of a house, and united together by hinges, the joints being covered by some flexible material which retained the gas, and allowed the sides to fold together. This was the first flexible expanding and contracting gas-chamber devised for coal gas purposes. Malam soon followed (1820) with a patent "For measuring the *flow* of gas," one of the contrivances being a flexible expanding chamber to be used as a governor or regulator, the water being dispensed with as used in Clegg's governor and flexible holder. A number of these chambers, or "bellows" as they were named, are arranged around a hollow valvular shaft, with which they revolve, and through which they are filled in succession. It is worthy of observation that as in the wet meter he obviated the use of the objectionable stuffing-box and hollow shaft, yet introduced it in a less practical form in this so-called dry meter. It is due to Malam that we should note that although the writer of the "History of the Gas-Meter" gives him the credit of having thus invented the first dry meter, he himself did not deem this a meter proper. It was a substitute for a clock, or, as he calls it, "the maintaining power," for clockwork to record the quantity of regulated gas passed by *inferential meter*. It was, however, a very suggestive arrangement, and served as a model for several inventors and patentees. A very zealous supporter of Malam, Peckstone, with Le Capelain patented, in 1841, a dry rotary meter; also Mr. Farwig in 1843, and a Mr. Duckham as late as 1860. The cylindro-piston form of chamber was patented, in 1823, by a Mr. Caslon, as improvements in gasometers—a "plunger" in a frame with air-tight material sides. A round "*diaphragm*" was patented, too, by Samuel Crosley in 1825, identical, it may be said, with the many thousands that are now to be seen on the top of the lamp-pillars in every large town.

The first *dry meter* patented was by Miles Berry, in 1833, the invention of an intelligent American workman, named Bogardus, and, though said to have been a rude piece of mechanism, yet in its measure or expandable chamber it was not approached in those subsequently produced by the persons who were said to have improved it. The diaphragm consisted of a large inflexible plate, moving upon a hinge, with flexible sides just sufficient to allow of the formation of the chamber, every portion of which was entirly under control, and differed materially from the long or semi-bladder form which was manufactured by the North Road Meter Company, at a loss of something like £24,000. In 1832 another meter of Bogardus's was patented by a Mr. Sullivan, and it is on this principle—two diaphragms—all, or nearly all, are now made. A round diaphragm was used, similar to Crosley's regulator diaphragm, considerably inferior as a measure to the first one, working upon a hinge; a *large* disc of leather being used, and but a *small* inflexible plate *in the centre*. The arrangement of Defries and Taylor is the next worthy of notice, and differs materially from the former. It was patented in 1842, and somewhat resembled Clegg's flexible holder in its measures, the flexible partitions being formed of several inflexible surfaces combined together by a flexible material, by which means the flexibility of each partition results from the bending of the partitions at the lines of junction. Croll and Richards very worthily followed these patentees. Though there is nothing strikingly original in their meter, yet the marked simplicity of their arrangement, and the correctness of the measure of their diaphragm—"a *large* disc of metal surrounded by *as narrow* a margin of flexible material as possible"—could not but be followed, as it has been, by general adoption, rather than what appeared to be the better measure of their immediate predecessors. Croll and Richards, it will thus be seen, have laid down a principle for the construction of this diaphragm—"a *large* disc of metal with as narrow a band of leather as possible"—but there is also another principle involved in their arrangement which scarcely allows this to be carried out in practice, that the disc shall not pass through its plane of connexion or attachment to the meter, so as to prevent, as far as possible, the bending of the leather when in action. This, however, has not been deemed essential by several makers, nor in practice does it seem of any importance. In Defries's diaphragm this action is more likely to be felt than in any other, and yet meters are taken down of this make, or of Croll's, that have been in use 20 years, and are perfectly sound. Unfortunately very few meters attain that age, but still there is sufficient proof that the bending of the leather, it being so very slight, is not injurious to it. Unquestionably there are cases in which it appears otherwise; diaphragms of Defries make have *appeared* to go at the bending, but upon examination it will be found that it has been caused by defective workmanship, as, in the case of the round diaphragm, a sharp edge of the tin has cut the leather, or it has received a blow. As experience will support this view, we may then reduce the quantity of leather employed by passing the disc through the plane of connexion, and thus reduce the quantity to a minimum. Meters are now being made upon this principle by Smith, Milne, and Messrs. Cowan, and they were also manufactured by Mr. Thomas Edge, in 1853, under a patent of my own.

We now come to the valvular arrangements, or the various modes that have been devised for passing the gas into and from these measures. In a letter to Malam from Clegg, in 1817, which was a caution against infringing the patent, he observes the shutting off the gas may be effected in various ways—that is to say, "by valves, or sealing the pipes with water." I quote Peckstone, who then adds, "If the reader examines the figures representing Mr. Malam's gas-meter, he will find there is not a valve in either, and also that there is not any pipe to be sealed with water." It is certainly due to Clegg that we should take him as our authority rather than Peckstone, and so we shall find that there are not only valves, but valves of a very beautiful description, in Malam's meter, and that they are partly in principle identical with Clegg's. Further, this passage quoted by Peckstone from Clegg is the strongest evidence we can have that Clegg was thoroughly alive to the imperfections of his meter. He at once put his finger upon them, and probably would have remedied them had not Malam's knowledge of the subject and ever active ingenuity been scarcely less than that of his chief. But it was not equal to that which Peckstone has given him credit for—getting gas into and from a vessel without an aperture. Such being necessary, and being opened and closed by the aid of water, became a valve the same in principle as Clegg's, though not the same in construction.

Looking at the drawing of Clegg's meter with, of course, the knowledge we possess now of the subject, and of which we cannot divest ourselves, improve-

ments in the action of the meter, similar to what Malam made, appear to suggest themselves. Thus by cutting the syphons in two, and lengthening the leg attached to the measure or chamber, the little buckets for carrying the water for sealing these syphons might be dispensed with. This, though not in form, is indeed in principle one of Malam's improvements, so altering the *inlet* that the ends of the pipes as they rose from and entered the water opened and closed as the wheel revolved, just the same as the *outlet* orifices were opened and closed by the drum revolving in Clegg's meter. In fact, Malam changed these outlet orifices of Clegg's meters into inlets, and placed the outlet passages at the rim of the wheel. By altering these syphons thus it will be seen that they displace the *spring*-valves for the *water*-inlets, the syphon legs forming inlet water-ways themselves into the chamber, and then we may almost trace the progressive steps of improvement in the formation of the wheel.

These water-ways, extending the whole depth of the wheel, were a decided improvement upon the small clack-valve used by Clegg, and a simplification of his curved ways, yet in one respect the action of the meter was similar: all the water to fill the chamber had to pass through these passages, and the whole of the water, the entire contents of the chamber, had to pass through each chamber in succession; the speed, too, at which it entered and left differed in Malam's meter, the inlet being at the centre, and the outlet at the rim of the wheel, the opening and closing of the gas inlet and outlet passages being, likewise, so affected, the variation of the water line would also affect the flow of gas through the meter. "Three-tenths of an inch of pressure," it appears, were absorbed by a "wheel 9 inches in diameter, and the difference of friction at various parts of the rotation of the wheel amounted to three-twentieths of an inch." The purchaser of Clegg's patent—Samuel Crosley—did not rest upon the patentee's ingenuity and experience, but exercising his own, which was considerable, and applying his practical knowledge of the working of metals, remedied these defects, and made the meter what it is this day—a good practical durable machine. He it was who gave the wheel the archimedian principle, placing the partitions spirally around the shaft, and doing the same with the inlet and outlet hoods, which he placed at the two ends of the cylinder, thus allowing the wheel to work freely through the water, instead of forcing it through the wheel; the friction being thus reduced, and the flow of gas uniform. The valves being placed at the two ends of the drum, and on opposite sides of the shaft, and extending from the same to the periphery, allow a variation of water-line without the flow or action being impeded. Wright also worked in this direction, and by cutting away a portion of the wood the friction was still further reduced, and the wheel could thus be made of less depth, and so approach a more correct measure; the two channels holding the measure of gas between them, and adapting themselves to the ever-varying water-line in a manner that is worthy of all admiration, but which is almost entirely overlooked, though scarcely second to Malam's improvements in beauty and simplicity; so simple, indeed, that Malam is almost justified in appealing to the observer to bear witness to the truth of his assertion that there are no valves. Yes, no valves! but by the formation of the chambers—no nicely adjusted mechanism, no carefully wrought surfaces, not a pin to move beyond the shaft—as rough and as simple as a grindstone, yet as delicate as the finest balance. Notwithstanding, we find patent after patent obtained for so-called improvements to supersede it by clicks and clacks, and gimcracks of every possible conceivable arrangement. Hydraulic, clack, slide, and rotatory valves have all been employed, with their usual and necessary accompaniments, in the formation of meters with the different kind of wet measuring-chambers to which I have alluded.

The first dry-meter valve, if we are to consider Malam's a meter, is a cylindrical one, but doubtless was made slightly conical; Berry's is a four-way cock; Paterson used the common clack; Sullivan's was a rotary; Defries and Taylor's slide, changed by Mr. Defries to the rotary; Wright's, as manufactured by Edge, a rotary, but afterwards changed to a slide; Croll has always used the ordinary D slide; Lizar's is a rotatary, or eccentric, of nearly a square shape; the North Road Company used one moving in an arc of a circle, which has also since been used by several persons; and Le Capelain has arranged one with a lever, or a flute key. Mr. Croll's is the only patent, I believe, for a composition of the ordinary metals used, and he employs a harder one for the cover than for the seat of the valve—the former being 6 parts of antimony to 16 parts of tin, and the cover 8 parts of antimony to 16 parts of tin. Mr. Defries tried glass covers, but abandoned them for leather, which has now been used for many years. The North Road Company used ivory at one time, which has been since patented, with glass, stone, pebbles, and glazed ware; and another inventor proposes to silver them; and, in opposition to this, another has claimed the exclusive use of felt. However, most—indeed, all—are manufactured of an amalgam such as Mr. Croll patented, differing more or less in the proportion; some also using lead, which is certainly objectionable. The faces are finished by grinding on stone and glass. Some makers use emery or other grinding powder, but I prefer the simple stone and glass alone.

We will now pass on to the construction of these machines—the various combinations of these elements that have been devised for the measurement of gas. Clegg's were constructed with two and three chambers, but the two-chamber was the one used. The water-line being below the axis, the meter in action resolved itself into a four-chamber meter, the surface of the water forming, as it were, the other two partitions. There is one disadvantage that is obvious to all in the two and three chamber meter; the number of partitions immersed is not the same in all parts of a revolution, and hence irregularity of flow. The number of chambers since Malam's has always been *four*, I believe; and Clegg followed the same example in his new eccentric meter. A Mr. Kromschroeder, who, I believe, had the management of the manufacture of this meter, patented an arrangement of five of these eccentric chambers.

In the reciprocating wet meter two kinds have been arranged—*single* and *double*. By *single* I mean the use of the *interior or exterior only* of the reciprocating vessel; the same, when the interior is used, as an ordinary gasholder, and externally by placing a cover over the same, using the exterior, and leaving the interior open to the atmosphere or *outlet* pressure; and *double* with this construction, but using alternately both sides of the vessel. Examples of the two in the dry meter will be found in Malam's radiating dry meter, the gas being admitted into the interior only; and the double principle will be found in Berry's first patent, in which the *diaphragm* is made to assume its proper functions, and divide the chamber into two measures, and so is double-action the same as an ordinary steam-engine. The combination and arrangement of these chambers, complete within themselves, of measure and valve, are very various. The most complete, perfect, and simple form unquestionably is that of the wet meter arranged around a horizontal shaft. This form is followed in Malam's dry meter. He also patented a wet meter, with four chambers arranged around a vertical shaft, and having a rotating undulatory action. One of the arrangements of Defries and Taylor, 1842, was *seven* diaphragms ("in preference!") separately acting upon and working the rotary valve affixed to an upright shaft.

In the year previous Peckstone and Le Capelain patented a dry rotatory meter and valve after the model of Malam's dry meter, only with a definite action, and consequently much more complex. The defects of the dry meter revolving on a horizontal shaft are obvious—an increase of friction by the *whole* apparatus having to be set in motion instead of but a very slight portion, and irregularity of action by balance of the wheel being destroyed by condensation. A Mr. Farwig, in 1843, claimed a number of arrangements of rotary meters with vertical spindles or shafts; and though they may not suffer from condensation, yet the whole has to be set in motion instead of a part, and a rotary valve must be used, or a hollow shaft and stuffing-box, and complications in detail upon which I need not dwell.

It need scarcely be said that the first dry meter proper—the double-action single-diaphragm of Berry—is the most simple in principle that can be made, and many attempts have been made to perfect it. A considerable amount of time, money, and ingenuity has been expended upon it, but it still remains the will-o'-the-wisp of patentees. Upwards of a dozen patents have been taken out for modifications of this principle. The defect is irregularity of action, the motion of the valve or valves being dependent upon an extraneous power, either spring or weight, to that derivable from the diaphragm; or rather, the power is supplementary to that of the diaphragm, and hence the action of this is affected by the irregular resistance of the weight or spring. The power of these, too, being constant, and the work actuating the valve or valves varirable, irregularity arises from want of precision in change. This is a defect that no amount of ingenuity can overcome. It is a defect in principle. The next most simple meter is that of the late Mr. Alexander Wright. I here come to his first recorded invention in the form of patent (1844), but it is assumed that it is well known he was connected with others, and that he devoted much and useful attention to the gas-meter. I feel that we are much indebted to him for practical as well as theoretical knowledge upon this subject, and take this opportunity of recording my admiration of his talents. His meter is that which was manufactured by Mr. Edge, and consists of three chambers formed by two diaphragms. Defries and Taylor—dare I say so?—were superstitiously attached to add numbers, and so amongst other arrangements patented three chambers, but formed them by three diaphragms—single-action, of course. Wright's, however, was much improved in form and construction, and overcame the defect of the two-chamber meter without being scarcely more complex, as in the latest improved two-chamber meter a second diaphragm was attached as a kind of regulator, and the valve—a rotatory one—was entirely under the control of the diaphragms. The two diaphragms were placed parallel, forming two external chambers proper, and one common to both, in which the rotary valve was placed, and was actuated by a central vertical shaft, which received direct action from the diaphragm through two cranks.

To those striving after simplicity, here is a noteworthy model, and, to those needing it, an example not to depart from first principles, and one of these, in the construction of meters, is surely that a *constant* flow of gas shall pass through the instrument. This is absolutely necessary—not even second to measurement; and, upon an examination of this principle, it will be seen that it fails in this essential. As in the four-chamber meter, there is in a portion of its action two chambers delivering, and hence one filling; to this we will not object, nor to the opposite of it—two filling and one delivering; but we may fairly object to the arrangement by which two diaphragms are in action and but the duty of one being done, or, in other words, in which each diaphragm has not only to do its own work but to carry its neighbour too, which is the case with this meter. The slide-valve was subsequently adopted, three single ones being used, the form, and action of which were decidedly bad; but with this alteration, I believe, Mr. Wright had nothing to do—indeed, objected to it. This meter needed but a sheet of tin between its diaphragms, and with one valve less would have been a better instrument. Mr. Smith patented such an arrangement in 1846—two years after Wright's patent—two cranks at right angles being placed in the interior of the meter, and the shaft passing through stuffing-boxes to the valve-chamber.

Before leaving Wright's meter, we must notice that the single-action diaphragm has this defect: that, whatever the power be required to move it—and it differs in different meters, and in the condition of those meters—that power becomes doubled, or rather the absorption of power of the single-action diaphragm is twice that of the double action. Had Sullivan's principle been followed closely by subsequent patentees and manufacturers, and the ingenuity expended upon modified principles been spent upon that meter, a better meter would have been produced at an earlier date, and much prejudice against the dry meter avoided.

In this was the success of the Croll and Richards. They took Sullivan's meter, enlarged the disc of diaphragm, reduced the quantity of leather, and brought it under control, substituted the slide-valve for the rotary, and otherwise so altered and improved the instrument that it has become, as Crosley's wheel has become, the model which all have followed. The meter of Defries and Taylor having six chambers, formed by the three solid diaphragms arranged triangularly in a very compact and neat manner, was unquestionably the first good practical meter in the market, and was well worthy of the popularity it created for itself. Defries has not been the only manufacturer of six-chambered meters. The ingenious Taylor, co-patentee of Defries, amongst many, many schemes that have come from his fertile brain, was a six-chambered meter, patented in 1844. The diaphragms, being single action, were coupled together in pairs, each pair having a separate crank, &c.—a complicated and troublesome arrangement. It was manufactured by Mr. Sugg, who afterwards very wisely modified the arrangement to the three-diaphragmed six-chambered meter. Several other makers have also manufactured upon this principle, including even the Messrs. Parkinson, of Cottage Lane, but who have since abandoned it for the four-chambered meter, as indeed the successor to Mr. Nathan Defries has done. We may, then, take it as an admitted fact that for all practical purposes—and our experience of one is equal to that of the other—the four-chambered meter has an advantage over the six. As less than four is defective, so more than four is an unnecessary complication and expense.

Not having had occasion to mention the names of Messrs. Glover and some other principal manufacturers, it is but right that I should here take the opportunity of saying that I have as high an opinion of their meters as any manufactured, but I have purposely confined myself to principles. Durability, dependent upon manufacture, is a question of experience, as is the cause of failure in action, and so fairly come within the scope of discussion. But the causes of variation in the registration and action of meters, and the examination of the arrangements that have been devised to maintain their accuracy and efficiency, will, with the permission of your committee, form the subject of another paper that I hope to have the honour of presenting to this association.

The Honorary Secretary read the following paper, by Mr. E. White, of Birmingham:—

ON DAVIES'S IMPROVED ROTARY EXHAUSTER.

The writer has been practically connected with the manufacturing of gas exhausters for the last 27 years, having perfected the first machine that was brought into general public use, and seeing the great increase in the manufacture of gas, called the writer's attention to the construction of an exhauster that would offer facilities for being carried out upon a large scale, and would work free and smooth with a small amount of friction, and also work at high or low velocity against a considerably higher pressure than is made use of in any of the ordinary gas-works. And in carrying out the invention two ordinary cylinders are employed, and arranged end to end, their axis being in the same horizontal line; and between the cylinder a partition-plate is secured by means of flanges on the abutting cylinders. Each cylinder is closed by a lid, and a rotating piston works in each cylinder, the pistons being carried by a horizontal shaft passing through both cylinders.

The pistons are not fixed at the same angle, but the part of the greatest radius of the piston in one cylinder is situated opposite the part of the least radius of the piston in the adjacent cylinder. On the front of each cylinder a horizontal nozzle is fixed, in which the outlet-ports or passages are made; sliding in the nozzles are plates, constituting stops or valves, the inner ends of the said plates bearing against the cylindrical surface of the rotating piston. Each sliding-stop works in channels made in the nozzle partition-plate and cylinder-lids. The channels are cut truly in the parts in the same plane as the face of the nozzle, and thereby form a perfect bearing for the stops to work upon, and prevent the escape of gas at these parts. These sliding stops when they are at the end of

their inner stroke divide the space between the piston and cylinder into two parts or chambers. In each cylinder and underside of the stop the inlet-port for the gas is made, the said inlet-port being always open; the outlet-port or passage being made in the nozzle hereinbefore described, which opens into the cylinder on the other side of the said stop.

By the arrangement described of the pistons on their shafts, the sliding-stops and valves are alternately moved backwards and forwards in their nozzles, and the outlet-ports in the said nozzles thereby alternately open and close. The two sliding-stops are connected together by means of links and lever working on a pivot, so that as the stop in one piston is moved outwards to close its outlet-port, the stop in the other cylinder is pressed inwardly against its piston to open its outlet-port. By the revolution of the piston in the cylinder, the gas which has been delivered on one side the stop is driven by the piston through the outlet-port on the other side of the said stop into the open nozzle. As soon as the piston has driven the gas in front of it from the cylinder, and is about to pass the sliding-stop, the outlet-port in the nozzle is closed by the said stop, and the gas which has entered the cylinder on the other side of the piston and stop is prevented from escaping through the outlet. On the continued rotation of the piston another volume of gas is forced out of the cylinder, and so on. The inlet and outlet ports, being narrow channels the whole length of the cylinders, admit of a short cessation of the impelling action of the piston, and the gas that has been forced into the outlet-main is prevented from returning by means of the sliding valves and stop covering the outlet-port. The revolving piston is made to work in close proximity to the inner surface of the cylinder, and it is very desirable that there should be a ready means of always keeping the revolving shaft in the centre of the cylinder, and by examining the model it will be seen that standard brackets are fixed outside the cylinder-lids for supporting the shafts, and are provided with a taper wedge cutter, screwed at each end, and passing through the bracket under the bottom of the bearing. Under the shaft a gauge is fixed, working on a pivot, which is so made that it will just pass under the shaft; and if at any time the shaft should wear down in the bearings, it is only necessary to slacken the nut at the large end of the wedge and tighten the nut at the small end, and may be repeated at any time without disturbing the internal parts of the machine.

The peculiar action of the motion in front of the nozzles always keeps the inner ends of the sliding-stops in close contact with the revolving pistons irrespective of wear or packing—an effect that has not previously been obtained. It will be seen by the model and drawings that all the parts in the machine are in perfect balance one with the other, and consequently the power required to drive it will be uniform, and the writer believes that no exhauster has yet been made that will give off the same amount of duty with an equal quantity of power to drive it. Under different pressures, he has found all through his experience that exhausters working without any internal packing are liable to a great amount of slip, even when contending against a small pressure; and those that require internal packing, and are not in balance, take so much extra power to drive them. The present invention will be found to remedy both of these evils.

ELECTION OF OFFICERS.

The SCRUTINEERS reported the result of their labours, which showed that the following gentlemen had been elected as officers, &c., for the ensuing year:—

President, Mr. Thomas Livesey.

Vice-Presidents, Mr. Edward White, Mr. T. N. Kirkham, Mr. G. Anderson.

Treasurer, Mr. Henry Newall.

Committee, Mr. I. A. Crookenden, Mr. George Garnett, Mr. Jabez Church.

Auditors, Mr. Leather and Mr. Hersey.

Hon. Sec., Mr. W. H. Bennett.

Mr. ANDERSON said he was much obliged for the honour intended to be conferred upon him, but would prefer to retire from the vice-presidentship in favour of the gentleman next highest on the ballot.

Mr. COX, of Sunderland, was accordingly elected one of the vice-presidents of the association.

Mr. GODDARD said he thought the present was the right time to take into consideration the afflictive dispensation which had deprived the association of the presence of Mr. Esson at these meetings, and, believing that it would be acceptable to the members, he would move the following resolution—"That the chairman be requested to convey to Mr. Esson our expression of sympathy and of condolence with him and his family under their present affliction."

Mr. WHITE (Birmingham) seconded the motion, which was put, and carried unanimously.

The PRESIDENT said the meeting would now proceed to the election of extra-ordinary members. The committee had considered the subject, and one of their number would make a few remarks upon it.

Mr. ANDERSON said, since the meeting of yesterday, when this matter was adjourned, the committee had considered it very carefully. The rule No. 4 of the association applied to the admission of extra-ordinary members who were declared to be persons taking an interest in matters connected with gas-works. That phrase had always been understood to mean gentlemen who were intellectually interested, and not merely interested in a commercial point of view. To some extent the rule had been broken through, owing rather to the peculiar position of some gentlemen, who happened to be connected both with gas-works and with manufacturing and business operations which brought them in contact with gas managers. The committee felt that while the rule No. 4 stood in its present form it would be unfair to exclude others somewhat similarly situated who might now apply for admission. At the same time they were quite aware of the strong feeling which had been often expressed, that the association ought not to allow extra-ordinary members to come in for the mere purpose of advancing their monetary interests. They were desirous to respond to that feeling, and, in order to reconcile their past conduct with their present desire, they suggested an alteration of a portion of the rule. Personally they could have no feeling against the introduction of any number of gas apparatus manufacturers, but there was an objection to their taking part in the proceedings, which, as the rule now stood, they could do. It was therefore proposed to add to the rule these words, "but they shall not be allowed to vote or take part in the proceedings unless requested to do so by the chair." The committee, in making this proposition, felt that many gentlemen might come in as extra-ordinary members who possessed a large amount of information, and would be able to interest the association and benefit it by the result of their experience, and they believed that these gentlemen would not take umbrage at the limitation thus put upon them.

Mr. C. WOODALL seconded the motion.

Mr. BROADHEAD asked whether the rule could be altered without notice.

The PRESIDENT said it could.

Mr. WARNER objected that the proposed alteration was a reflection upon those gentlemen who now sought admission. They ought to be elected on the same terms as those already admitted, and the rule altered afterwards. He moved as an amendment—"That these gentlemen be admitted on the present rules of the association."

Mr. DOUGLAS seconded the amendment.

Mr. ANDERSON said the committee had considered that view of the question, and they had come to the conclusion that if the rule was ever to be altered it was better to do it at once.

The PRESIDENT said he did not think the gentlemen who were candidates for extra-ordinary membership at the present moment would consider the alteration cast any reflection upon them. It was a very important matter, and, as he understood from the conversation on the previous day, it was apprehended that under the existing rule the extra-ordinary members might in time come to swamp the ordinary members of the association.

Mr. ANDERSON thought it would be more disrespectful to admit the candidates now proposed, and to alter the rule afterwards.

Mr. CATHELS, on the other hand, thought the alteration would be a reflection upon them, and he could not at all understand what objection there was to the introduction of extra-ordinary members. Many of them were better acquainted with their special subjects of study than the ordinary members of the association, and their admission would add to the common stock of experience. He was at a loss to know what questions were likely to arise in which the votes of extra-ordinary members would peril the interests of the association.

Mr. JONES said at the present time there were nine extra-ordinary members, who were elected on the understanding that they would have the right to take part in the proceedings at the meetings. The association had received £5 from each of them, and it would be an act of injustice to deprive them, by an alteration of the rules, of one of the privileges, on the faith of obtaining which they became members. He suggested to the committee that it would be better to withdraw the resolution.

Mr. JOHN AIRD, as an extra-ordinary member, said his own feeling was that to deprive this class of members of the right to take part in the proceedings would be to take away the pleasure they had in being connected with the association. It was entirely in the hands of the members to refuse to elect persons whom they considered not worthy to be admitted, or who were without sufficient discretion to act as gentlemen when elected.

After some further conversation, in which Mr. Irons, Mr. Goddard, Mr. Methven, Mr. Craven, and others took part, the amendment was withdrawn, and the following substituted on the motion of Mr. WARNER, seconded by Mr. DOUGLAS—"That the applicants who have now been nominated for extra-ordinary membership be elected according to the present rule of the association."

Mr. SIMPSON said he had been a member from the commencement, and he could vouch for the great intelligence and energy which the extra-ordinary members had displayed. Until last year he was on the committee, and knew that no inconvenience had ever been sustained by them. He thought, therefore, it would be doing a great wrong if, without any excuse, they now limited the privileges of that class of members.

Mr. H. P. STEPHENSON objected to the amendment only because it proposed to elect the extra-ordinary members on the present occasion hodge-podge. He thought it would be better to alter the terms of it, and simply say—"That the original rule be adhered to," and then proceed to the election accordingly.

The amendment was put and carried.

The following gentlemen were then elected extra-ordinary members of the association:—

Williams, F.	Mark Lane, London.
Pollard, J. W.	Mincing Lane, London.
Robertson, G.	Leadenhall Street, London.
Fraser, W.	Inverkeithing.
Donaldson, A.	Edinburgh.
Horsley, C.	Wharf Road, London.
Payne, G.	Millwall, London.
Thorneloe	London Wall, London.
Waller, G.	Holland Street, London.

Mr. METHVEN proposed an alteration in rule 7, to the effect that the presidents, past presidents, and treasurers shall be *ex officio* members of the committee.

Mr. ARNOTT seconded the motion.

Mr. IRONS objected, because he thought the increase of *ex officio* members would lead to the transfer of the business of the association from the hands of the representative members of the committee.

Mr. H. P. STEPHENSON approved of the proposed alteration, because it was desirable to have gentlemen connected with the management who had some practical knowledge of the working of the association.

Mr. GARNETT said in municipal government it was found a very wholesome rule to continue the ex-mayor as a magistrate for the twelve months succeeding his tenure of office, as it gave the corporation the benefit of the experience he had obtained. But because a man had once attained the highest honour which it was in the power of his follow-members to confer, to make him a member of the administration for ever was not likely to work well. It would remove the difficulty, and perhaps meet the view of the proposer of the motion, to say, "the president, &c., for the past year."

Mr. METHVEN accepted the alteration.

Mr. A. WILLIAMS objected to any alteration of the rules without due notice.

The PRESIDENT ruled that notice must be given.

Mr. SIMPSON proposed an amendment in rule 37.

The PRESIDENT said the committee would consider the subject, and bring it forward at the next meeting.

On the motion of Mr. LIVESEY, seconded by Mr. GODDARD, thanks were voted to the scrutineers for their services, and Mr. PLUMB acknowledged the compliment.

Mr. DOUGLAS moved, and Mr. HUNTER seconded, a resolution, which was adopted, giving the committee on the benevolent fund and Sunday labour questions power to increase their number to nine, of whom three are to form a quorum.

On the motion of Mr. C. WOODALL, seconded by Mr. E. WHITE, it was resolved—"That the most cordial thanks of this meeting be presented to the gentlemen who have so kindly furnished papers and drawings for this session."

A conversation then arose with reference to the place for holding the next meeting.

Mr. JONES, of Dover, proposed Dublin, and expressed a hope that the members of the North British Association would attend the meeting. He also suggested that the committee should send an invitation to our American cousins to favour the association with a visit.

Mr. WOOD, of Bury, seconded the motion.

Mr. BROADHEAD brought forward his usual motion in favour of Leeds, in which he was seconded by Mr. HOLMES.

Mr. GODDARD, looking to the marked success which had always attended the sittings in the metropolis, moved—"That the next meeting be held in London."

Mr. SLIP, of Redhill, seconded the motion, and on a show of hands there appeared—

For Dublin	47
,, Leeds	6
,, London	37

It was, therefore, decided to hold the next sittings in Dublin.

Mr. M'NIE moved—"That the cordial thanks of the meeting be given to the committee for the manner in which they have conducted the business of the association during the past year."

Mr. WARNER seconded the motion, and at the same time acknowledged the vote of thanks which had just been presented to the contributors of papers.

The motion was very cordially adopted, and Mr. LIVESEY acknowledged the vote.

On the motion of Mr. SIMPSON, seconded by Mr. CRAVEN, thanks were given to the treasurer for his past services.

Mr. W. C. PARKINSON, on behalf of the visitors, tendered thanks to the association for the opportunity afforded them of being present during the session.

Mr. CATHELS moved, and Mr. WARNER seconded, a vote of thanks to the council of the Society of Arts for granting the use of the rooms for this meeting,

and also to Mr. P. Le Neve Foster, their secretary, for the courtesy shown by him in connexionwith the arrangements.

Mr. DUNNING moved, and Mr. GODDARD seconded, a vote of thanks to Mr. Ohren for his admirable inaugural address, and for the ability with which he had presided over the business of the sittings.

The motion having been unanimously adopted,

Mr. OHREN said: Gentlemen, I thank you very much for this cordial recognition of my desire and endeavour to serve the association. I assure you it has been a great pleasure to me not only to prepare the address which I had the honour to read, but also to preside over the interesting and important proceedings at these meetings. If in doing so I have given you satisfaction I am abundantly rewarded for any labour it has occasioned me.

Mr. WOODALL moved, and Mr. WHITE seconded, a vote of thanks to Mr. W. H. Bennett, the honorary secretary of the association, for the very careful and laborious attention which he had bestowed upon the duties of his office during the past year.

The motion was unanimously adopted.

Mr. BENNETT: Gentlemen, I am really very much obliged to you for the kind expression of your approval of the manner in which I have endeavoured to discharge my duties. I am pleased to find that the association is progressing so rapidly, both in numbers and in usefulness, and it is an additional pleasure that I am permitted to contribute, as far as I am able, to promote its efficiency.

The proceedings then terminated.

THURSDAY, JUNE 9.

This morning the members and friends, to the number of about 180, proceeded by special steamer to visit the new gas-works of the Chartered Company, in course of erection at Beckton. On their arrival they were met by Mr. F. J. Evans, the company's engineer-in-chief, from whose designs and under whose superintendence the works are being built, who most courteously conducted them through every department, and exhibited the series of elaborate drawings prepared by him in connexion with this great undertaking. The inspection afforded the highest satisfaction, and Mr. Evans afterwards entertained the party to a substantial luncheon, to which full justice was done. The health of Mr. Evans and "Prosperity to the Chartered Gas Company" were subsequently drunk with enthusiasm. On the voyage down the river the boat halted at Messrs. Brown and Co.'s wharf, Deptford, where an opportunity was afforded the members to witness the performance of Burleigh's patent steam and pneumatic rock-drilling machine, and on the return voyage a visit was paid to the iron-works of Messrs. S. Cutler and Sons, and the sulphate of ammonia works belonging to Messrs. Simpson, Payne, and Co., at Millwall.

PROPOSED AMENDMENTS IN THE SALES OF GAS ACTS.

The Fourth Report of the Royal Commissioners appointed to Inquire into the Condition of the Exchequer (now Board of Trade) Standards, on the Inspection of Weights and Measures, &c., has just been presented to Parliament.

The commissioners consider the whole subject under the heads of—

The Inspection of Weights and Measures, as established in 1835, under the Act 5 & 6 Will. IV., c. 63: and

The Inspection of Gas-Meters, under the Sale of Gas Act, 1859, 22 & 23 Vict., c. 66.

We extract that portion of their report which deals with the second division.

INSPECTION OF GAS-METERS.

The system of verifying and inspecting gas-meters is of recent origin, having been established under the Act 22 & 23 Vict., c. 66., passed in 1859. This Act provides that inspectors of gas-meters should be appointed in every county of the United Kingdom, and in every city and borough and town supplied with gas, the duties of such inspectors, in relation to the verification and inspection of gas-meters, being analogous to those of inspectors of weights and measures.

Soon after the passing of this Act, and before it came into operation, many complaints of its imperfections were made on the part of gas companies and of manufacturers of gas-meters, and bills were consequently introduced into Parliament in the following session to amend the Act of 1859, and were submitted to a select committee of the House of Commons, by whom evidence was heard and the subject fully considered. A bill, as amended by the select committee, repealing the Act of 1859, and recasting it with further provisions, was submitted to the House, but at too late a period of the session to be proceeded with. Nor has any proposal for altering the general provisions of the Act of 1859 been since brought under the consideration of Parliament.

A short amending Act was, however, passed in 1860, which has materially interfered with the carrying out of the Act of the previous session. The preparation of the gas-measuring standards not having been completed within the time fixed for the Act coming into operation, a further Act was required to extend the time, and a clause was introduced providing that notwithstanding anything contained in the Act of 1859, it should not come into operation in any county until the magistrates in quarter sessions, or other local authorities, should have resolved to bring the county under its operation.

The reasons for making this important alteration are contained in a letter to the Secretary of State for the Home Department from Earl Cathcart, chairman of the North Riding Quarter Sessions, dated the 24th of February, 1860, which was laid before Parliament. The objections against adopting the Act were based on the alleged large expense it would entail on the great mass of the ratepayers, without any corresponding benefit except to comparatively few persons.

The magistrates of the counties in the metropolitan district not having adopted the Sale of Gas Act, 1859, the powers conferred upon them were transferred by an Act passed in 1861, 24 & 25 Vict., c. 79, to the Metropolitan Board of Works, and have since been effectually carried out. On the suggestion of the board, a bill was introduced by the Government, in 1863, for making some amendments in the Act of 1859, but was not proceeded with.

The insufficient extent to which the provisions of the Sale of Gas Act, 1859, have been as yet carried out may be seen from the fact that the Act has been adopted, by the appointment of inspectors and by providing verified copies of the gas-measuring standards, and official stamps of verification, in the following localities only:—

In 1 county (Gloucestershire).
7 cities (including the City of London), which are counties of cities.
1 metropolitan district, divided into 4 districts of inspection.
44 other cities and boroughs.

Total 53 districts of inspection of gas-meters.

It is important to observe that it has been shown to us that, since the passing of the Act of 1859, powers have been obtained by various gas companies in their local Acts, with the view of protecting their own interests, which powers have materially affected the working of the Sale of Gas Act, and tend to defeat its provisions. We think it essential that the attention of the Government and of Parliament be drawn to the necessity of taking effectual means for preventing the provisions of general law relating to the inspection of gas-meters being thus set aside by clauses in local Acts subsequently passed.

It has been shown to us that the use of gas is being largely extended from year to year, and we think that it is not a right principle of legislation that a general law, enacted for the protection of the public at large, should be set aside in nearly every district throughout the kingdom, merely because the county magistrates do not volunteer to adopt it. As the law now stands, there is this dilemma, that the boroughs cannot, and the counties will not, adopt the Act of 1859. A consideration of all the circumstances of the case has led us to the opinion that the law in this respect requires amendment, and that it is expedient to establish a more general and uniform system of inspection of gas-meters, such as is now established in the metropolitan district.

To effect this object, it is in our judgment requisite that further provisions should be made with the view of securing the exercise of the duties of verifying gas-meters by duly competent persons, and that the appointment of the officers and the execution of their duties should be placed under the control and supervision of the Board of Trade, as in the case of verifiers of weights and measures.

It has appeared to us that the duties of inspection, with a view to penal consequences, which are required in the case of weights and measures used by tradesmen, are clearly inapplicable to gas-meters used only by individual consumers; and although it may be expedient to maintain the legal power of inspecting gas-meters by the local inspectors, when called upon for this purpose either by the gas company or the consumer, practically the duties of inspection of gas-meters, as distinct from their verification, will continue to be discharged by the inspecting officers of the gas companies, and the duties of the local officers charged with the inspection of gas-meters will be limited to their verification.

The ground of objection successfully urged in 1860, on the part of the counties, against adopting the Act of 1859—viz., that of expense—appears to us to have now lost nearly all its force. It has been shown to us that in the metropolitan district the annual receipts from fees for verifying gas-meters now exceed the whole expenditure, and we think that if the provisions of the Sale of Gas Act were more generally adopted throughout the kingdom, it is probable that even in the more extended districts of inspection, where no separate inspecting officer of gas-meters may be required, by the consolidation of the duties of verifying gas-meters, and weights, measures, and balances, and by improvements in the system, the total receipts from fees of verification may be made considerably to exceed the total expenditure for the discharge of these duties.

Some detailed information upon the working of the Sale of Gas Acts up to the present time, with suggestions for alterations in the law and practice, have been furnished to us by competent persons who are practically acquainted with the subject, and these papers are now appended.

Proposed Amendments in the Sale of Gas Acts.

Considering that important amendments in the Sale of Gas Act, 1859, were fully considered and agreed upon by a select committee of the House of Commons in 1860, but have not since been embodied in an amending Act, and that we are satisfied, from information which has been laid before us, that it is expedient such amendments should generally be carried into effect;

That a short amending Act was passed in 1860, containing a provision for allowing magistrates in counties the option of adopting the Act of 1859, the effect of which has been to make the Act of 1859 a dead letter throughout a great part of the United Kingdom, so far as regards the inspection of gas-meters;

That the grounds of such provision appear in a letter from Earl Cathcart, dated Feb. 24, 1860, which was laid before the House of Commons; but that it appears to us that there is now little force in the objections thus raised, which were based upon the apprehended large expenditure to be defrayed from county rates, and that such objections should no longer stand in the way of the application of a general law, and prevent the establishment of a uniform and efficient system of inspection of gas-meters throughout the kingdom;

That with the view of establishing such a system, it is obviously expedient to adopt the several regulations relating to the verification and inspection of weights and measures, so far as they may be properly applicable to gas-meters;

That under the provisions of the Act of 1859, accurately verified copies of the gas-measuring standards, of a primary character and of similar construction to the official standards, have been supplied at the public expense to the Corporations of London, Edinburgh, and Dublin; and that it is expedient that provision should be made by which the standards thus supplied to the metropolitan cities of Scotland and Ireland may be made more serviceable to the public;

We recommend that the Sale of Gas Act, 1859, and subsequent Acts relating to it, be repealed, and their provisions re-enacted in the proposed Act for amending and consolidating the laws relating to weights and measures, with the following modifications:—

That such provisions be adopted in every county, and in every city and borough throughout the United Kingdom, where gas is manufactured and sold, under the authority of Parliament, except in such counties in England and Wales in which the magistrates in quarter sessions, or in Scotland the commissioners of supply, or in Ireland the grand jury, shall determine, by a resolution to be passed within a limited period by a majority of not less than two-thirds of those present, that there are not sufficient grounds for adopting such provisions, a copy of such resolution being laid before the Board of Trade.

That the local authority over the inspection of gas-meters be in all cases exercised by the county magistrates, except in the metropolitan district, where it should remain under the Metropolitan Board of Works, and in such cities and boroughs as Parliament may determine, with respect to the sale of gas, as well as in such cities and boroughs as may be situated in counties in which the local authorities stated in the preceding resolution shall have determined not to adopt the Act, where it should be exercised by the local magistrates.

That in all such counties where no inspector of gas-meters may have been appointed, and copies of the gas-measuring standards provided, the duties of comparing, verifying, and stamping gas-meters be exercised by the verifier of weights and measures, who shall be furnished with the requisite gas-measuring standards and other appliances.

That no copy of the gas-measuring standards be legal that shall not have been reverified by the Standards Department within a period of 10 years.

That no copy of the gas-measuring standards that shall have been altered or readjusted, after verification by the Standards Department, be legal until it shall have been reverified by the Standards Department.

That provision be made by law for authorizing the Board of Trade, if they should so think fit, to make regulations for the verification at Edinburgh and Dublin, by the chief verifier of those cities respectively, of copies of the gas-measuring standards used by inspectors in the several local districts of Scotland and Ireland, by comparison with the primary copies deposited at the two metropolitan cities, and under the directions of the Standards Department.

That upon the verification by the Standards Department of such copies of the gas-measuring standards as may be provided for any new district, the requisite verification stamps for gas-meters, bearing the number of the district, be furnished to the verifier by the warden of the standards, without any charge for the same.

That from and after a specified period from the passing of the Act, all verification stamps for gas-meters which have been furnished from the Standards Department for the use of inspectors of gas-meters under the existing law be no longer legal, and be returned to the Standards Department, and that new stamps for verifying gas-meters be provided and issued by the warden of the standards, at the charge of the department, to such districts as shall require them, bearing the proper number of the district.

That all such verification stamps shall be and remain the property of the Board of Trade, who shall be empowered to reclaim them upon sufficient grounds of misuse or otherwise.

That all such duties of verification and inspection of gas-meters be exercised according to instructions and regulations to be issued from time to time by the Board of Trade, and that similar powers and authorities in relation to the construction, and the control and supervision of the verification of gas-meters, and to the appointment, duties, and apparatus of the inspectors of gas-meters, &c., be extended to the Board of Trade, as in the case of weights and measures.

That no gas-meter be legal that shall not have been reverified and restamped within a period of 10 years after being fixed and used.

That all the regulations for licensing or registering makers of weights and measures, &c., and for stamping such weights and measures with the mark of the maker, be made applicable to makers of gas-meters, and to gas-meters made and sold by them.

That in the comparison and verification of gas-meters, the verification of their indices or registering apparatus, according to the official instructions of the Board of Trade, be included.

That every gas-meter so compared and verified be marked with the number of lights it is constructed to supply, each light being computed to consume 5 cubic feet of gas per hour, with a pressure equal to a column of water 0·5 inch high.

That the fees for testing gas-meters be regulated in pursuance of a scale to be notified from time to time by the Board of Trade, according to the number of lights which each meter is constructed to supply.

That the fees for the separate testing of the indices of gas-meters be also regulated by the Board of Trade.

Powers and Duties of the Board of Trade in relation to the Verification and Inspection of Weights and Measures and Gas-Meters.

Considering that as regards the whole of the existing system of verification and of inspection of weights and measures and of gas-meters, the great and principal defect appears to us to be the want of an efficient central control to give force and unity to local action, as pointed out in the report of the select committee on weights and measures in 1862;

That without such control and authoritative direction there can be no adequate security to the public for a uniform administration of the law, or a due compliance with its requirements, nor for the proper discharge of the duties imposed upon the local authorities and officers;

That it appears to us that these defects in the existing system may best be remedied by the requisite control and supervision over the local officers, and the duties discharged by them being exercised by a responsible public department, and that this control be extended to the appointment and remuneration of these officers;

That the necessary powers for these objects should be given by law, and should include the issue from time to time of authoritative instructions for the guidance and government of the local officers;

That in order to make such control effective, and to secure that the official instructions are duly carried out, and the duties of the local officers adequately performed, it is in our opinion requisite that supervising public officers should be appointed under the authority of such department;

That it appears to us to be also expedient, for the due protection of the public, that further provision should be made by law for securing, as far as may be, that all weighing and measuring instruments sold for public use should be properly and justly made, and in accordance with the established regulations;

That for this object, and in order to bring all makers of such instruments under the congnizance of a public department, and render them in some degree responsible for their instruments, it is expedient that every maker and repairer or adjuster of these instruments, should be duly registered, and that an annual licence duty, payable by means of a stamp upon the annual certificate of registration, should be imposed upon every such maker and repairer or adjuster, thus more completely carrying out the recommendation, applicable to gas-meters, adopted by the select committee of the House of Commons, in 1860, on the bills for amending the Sale of Gas Act;

We recommend that the Board of Trade be charged with such powers, in relation to the appointment, remuneration, and duties of verifiers and inspectors of weights and measures and of gas-meters, as are mentioned in the preceding recommendations.

That two or more inspectors of standards be appointed by the Board of Trade as officers of the Standards Department, with adequate salaries and allowances for travelling expenses; and that they be subordinate to the warden of the standards, and report to him from time to time.

That each official inspector of standards be provided with sufficient copies of the official standards, and such other instruments as may be requisite for comparing and verifying the local standards and apparatus in the several districts of verification and inspection of weights and measures. That he proceed from place to place within the district assigned to him, previously giving notice to the verifier, or the chief officer of police, or other chief inspector responsible for the duties of inspection of weights and measures and of gas-meters, to have his standards, balances, and other apparatus ready for inspection at such place and time as may be fixed from time to time by such official inspector, so that each district of verification and of inspection may be visited at least once in each year.

That it be the duty of the official inspector of standards to see that the office accommodation of each verifier, and the standards, balances, and other apparatus, are fit and proper for the execution of his duties, as well as the standards and other instruments of the inspectors of weights and measures and of gas-meters; and to ascertain, so far as lies in his power, that the provisions of the weights and measures laws, and the official instructions of the Board of Trade for carrying out the law, are duly complied with by such verifier and inspector.

That in case of any of the local standards being found to be defective beyond an allowance to be fixed and determined from time to time by the Board of Trade, the official inspector require them to be immediately adjusted and duly reverified by the Standards Department, provided he deem them fit to be corrected as standards; and that if he find them to be defective or damaged so that they cannot be made fit standards, he at once condemn them, and cancel the official stamp upon them, so that they can no longer be used as standards.

That in all cases, after due notice shall have been given to the verifier or chief inspector, by the official inspector of standards, that any of the standards in his custody are defective or unfit for standards, and such standards shall not have been duly adjusted and verified, or replaced with new standards duly verified, after the expiration of three months from the date of such notice, the Board of Trade be empowered, upon the report of the warden of the standards, to direct the necessary steps to be taken for publishing in the local newspapers a notice that the district of verification or inspection is not furnished with legal standards of such denominations.

That in all cases in which such offices, balances, or other apparatus, other than standards, shall be found by the official inspector to be unfit for the proper execution of the duties of verification or inspection, he certify the same in writing to the verifier or chief inspector, and require that the necessary steps be taken for placing them in fit condition, and that he report accordingly to the warden of the standards; that he also require such verifier or chief inspector, within one calendar month, to report to the warden of the standards what steps shall have been taken in pursuance of the requisition of the official inspector; and in the event of such steps not being considered satisfactory by the Board of Trade when reported by the warden of the standards, the board be empowered to authorize him to require the local authorities at once to direct the necessary steps for placing such offices, balances, or other apparatus, in fit and proper condition.

That authoritative instructions be from time to time issued by the Board of Trade to the several verifiers of weights and measures, and inspectors of gas-meters, with the view of ensuring uniformity of action in the execution of their duties, and due compliance with the laws as construed by the highest legal authorities.

That authoritative instructions be also issued to the chief officer of police, or other chief inspector in the several districts of inspection of weights and measures, with the view of ensuring uniformity in the mode of testing the legality of weights, measures, and balances.

That such instructions comprise all necessary directions for the form, material, and mode of construction of the local standards, together with the balances, stamps, and other apparatus to be used by verifiers and by inspectors of weights and measures and of gas-meters, and for their preservation and use; and include also the scale of tolerance of errors in the official comparison and verification of local standards.

That such instructions also comprise directions for the form, material, and mode of construction of all weights, measures, balances, weighing-machines, and gas-meters to be stamped by the verifiers of weights and measures, and inspectors of gas-meters, and legalized for use.

That the Board of Trade be empowered to make regulations from time to time for comparing and verifying with the official standards all weights and measures for scientific purposes or otherwise, in which special accuracy is required, and for charging such fees as shall be fixed by them for the comparision and verification of such weights and measures; but that no fee be charged for the official verification of local standards.

That the Board of Trade be also empowered to make such special regulations as they shall deem fit for the testing of large station or other gas-meters constructed to pass more than 10 cubic feet of gas at one revolution or complete action of the meter.

That all instructions and other regulations authorized by law to be issued and made by the Board of Trade in relation to the verification and inspection or otherwise of weights and measures and other instruments, be published in the *London*, *Edinburgh*, and *Dublin Gazettes*, and copies laid before Parliament not later than in the next session after the date of their issue.

That the Board of Trade be authorized to require the verifiers and chief officers of police, or other inspectors of weights and measures and of gas-meters, to make from time to time such returns to the warden of the standards in relation to the execution of their duties of verification and of inspection, and in such specified form, as the Board of Trade shall think fit.

That every maker, repairer, or adjuster of weights, measures, and balances, or weighing-machines, and of gas-meters, be duly registered in the standards office before the 31st of January in every year, and a certificate of registry issued to him by the warden of the standards, bearing a £5 stamp.

That the distinctive mark of every such maker be approved and recorded at the standards office before being used.

That such mark be required to be stamped upon every weight, measure, balance, or weighing-machine, or gas-meter, before it is sold or used, under penalty.

That a penalty be imposed by law upon any maker who shall mark any such weight, measure, balance, or weighing-machine, or gas-meter, without being duly registered.

That a similar penalty be imposed upon any fraudulent imitation of the mark of such registered maker.

Other Provisions.

Considering that it is, in our opinion, requisite that the important changes recommended by us to be made in the existing laws and practice relating to weights and measures should be introduced into Parliament on the responsibility of the Executive Government, and be supported by their authority;

That it has been proved to us that powers have been frequently granted by Parliament in local and personal Acts to corporations and persons, which powers are inconsistent with the provisions of the general laws relating to the verification and inspection of weights and measures and of gas-meters, and tend to prevent the establishment of a uniform and efficient system;

We recommend that it is expedient that a bill be brought into Parliament by the Government, at the earliest period, to amend and consolidate the laws relating to weights and measures and the standards of weight and measure, and to the sale of gas, and for carrying into effect the preceding recommendations.

That provisions be also contained in this bill for carrying out the recommendations of the commission in their second report, relating to the permissive introduction of the metric system of weights and measures into this country, and in their third report, on the abolition of troy weight.

That all provisions of former Acts which relate to the standards of weights and measures, and to the legalization, verification, and inspection of weights and measures and gas-meters, be repealed, such of the provisions as are not inconsistent with the preceding recommendations being embodied in the amending and consolidating bill; and that the powers of verification and inspection of weights and measures granted by such Acts, or by charter, custom, or otherwise, shall cease and determine.

That provision be made for granting such compensation to the Founders Company for any loss which may be sustained by them through abolition of their ancient rights of verifying brass weights, as the Commissioners of Her Majesty's Treasury shall think fit.

That tables of all the denominations of legal weights and measures be appended in a schedule to the bill.

That the Executive Government take the necessary steps for the adoption of such means as may tend effectually to prevent the provisions of the general law for establishing a uniform system of verification and inspection of weights and measures and of gas-meters from being defeated by clauses subsequently introduced into local Acts.

AVERAGE COMPOSITION AND QUALITY OF THE METROPOLITAN WATERS, JULY, 1870.—The following are the returns of the Metropolitan Association of Medical Officers of Health:—

NAMES OF WATER COMPANIES.	Total Solid Matter per Gallon.	Oxygen required by Organic Matter, &c.	Nitrogen.		Hardness.	
			As Nitrates, &c.	As Ammonia.	Before Boiling.	After Boiling.
Thames Water Comps.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
Grand Junction	16·57	0·080	0·075	0·002	12·8	3·3
West Middlesex	17·13	0·050	0·091	0·000	12·9	3·3
Southwark and Vauxhall	17·83	0·080	0·060	0·001	13·5	4·0
Chelsea	17·10	0·053	0·080	0·000	13·2	3·6
Lambeth	19·20	0·071	0·049	0·001	14·0	4·0
Other Companies.						
Kent	27·00	0·017	0·146	0·000	20·0	5·3
New River	16·43	0·027	0·060	0·000	12·9	3·3
East London	17·37	0·047	0·075	0·000	13·0	3·9

Note.—The amount of oxygen required to oxidize the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and, in the case of the metropolitan waters, the quantity of organic matter is about eight times the amount of oxygen required by it.

The water was found to be clear and nearly colourless in all cases but the following, when it was slightly turbid—namely, in the case of the Lambeth companies water. The average quantity of water supplied daily to the metropolis during the preceding month was, according to the returns of the water companies to the Association of Medical Officers of Health, 114,752,521 gallons; and the number of houses supplied was 478,890. This is at the rate of 35·7 gallons per head of the population daily. The last official return from Paris stated that the average

daily supply per head of the population was 23 gallons; but this includes the water used for the public fountains, and for the ornamental waters in the Bois de Vincennes and the Bois de Boulogne. HY. LETHEBY, M.B.

DR. STEVENSON'S REPORTON THE GAS SUPPLIED BY THE IMPERIAL COMPANY TO THE VESTRY OF ST. PANCRAS DURING THE MONTH OF JUNE, 1870.

Date.	Number of Observations.	Average Light in Candles produced by 5 Ft. of Gas per Hour.	Light in Candles reduced to Consumption of 120 Grs. per Hour.	Traces of Ammonia.	Traces of Sulphuretted Hydrogen.
June 2	10	13·7	14·2	Present.	None.
4	10	15·3	15·7	,,	,,
8	10	13·4	13·7	,,	,,
14	10	14·5	15·1	,,	,,
16	10	13·5	14·5	,,	,,
21	10	14·4	14·4	,,	,,
21	10	14·5	16·5	,,	,,
25	10	14·6	15·4	,,	,,
25	10	14·4	15·2	,,	,,
28	10	13·6	14·5	,,	,,
28	10	14·0	14·6	,,	,,
30	10	14·3	15·4	,,	,,

The average illuminating power of the gas was 14·9 candles, the maximum being 16·5, and the minimum 14·2 candles. Of impurities, ammonia was always present, and sulphuretted hydrogen was invariably absent; sulphur was present to the amount of 17·47 grains per 100 cubic feet.

THOS. STEVENSON.

ACTION AGAINST THE SOUTH SHIELDS GAS COMPANY.—At the last Durham Assizes, before Justice Lush, W. Dixon, of South Shields, a cartman, keelman, and coal trimmer, sued the company for damages for personal injury sustained through their negligence. In December last he was employed, at 17s. a week and overtime, by Mr. Copeland to remove coals for the gas company, who, as alleged by the plaintiff, are the owners of a coal-spout near the North-Eastern Station at South Shields, used for the purpose of bringing coals to the town, and carting them to the gas-works. He was engaged in filling his cart with coals beneath the spout, when a man on the top shouted to him that he was going to send coal down. The plaintiff went to his horse's head, and was standing clear of where the coal was to fall, when the whole of the spout, the rails, and three waggons of coal came upon him, and completely buried him. He was very nearly killed, and remained insensible for three days, and was in bed for five or six weeks. It was four months before he got work, which was to coal the steam ferry, but he is still dizzy when he works hard. As a keelman he sometimes made £3 or £4 a week, but his average was £2. He was now unable to work as a keelman. Mr. Quain, for the defendants, said the directors of the company entirely sympathized with the unfortunate man who had been injured. There could be no doubt as to the accident, the coals fell upon the plaintiff in the way described, but he was getting better, and was earning more money than ever. The question, however, was rather one of liability than of damages. He submitted that there had been no negligence on the part of the gas company, and that the plaintiff should have brought his action against the railway company. Mr. Copeland, the contractor, and Mr. Warner, the engineer of the gas company, were called. The latter said that only the spout came down, and that it had not been attached to the beams. His lordship said he was of opinion that the gas company were not liable, but would reserve the point for the court above. He asked the jury to say what amount of damages they thought the defendants ought to pay supposing they were liable. The poor man was certainly a victim to this terrible accident, and was entitled to reasonable compensation for the sufferings he had undergone and would undergo, and also for the pecuniary loss he had sustained and would sustain. The jury found a verdict for £150, and leave was reserved to the plaintiff to move for that amount.

Register of New Patents.

2081.—JOSEPH BEARD, of Droylsden, in the co. of Lancaster, brassfounder, for "*Improvements in pumps.*" Provisional protection only obtained. Dated July 10, 1869.

In carrying out this invention a rack is employed which is furnished with cogs, and is of such a length as may be necessary for the full stroke of the piston and which may be fixed to the frame or support that carries the pump. Into this rack gears a segment of a wheel, on one side of the centre of which is formed a handle or lever, or a socket may be formed instead into which a handle or lever can be inserted. The piston-rod of the pump is attached to the centre of the segment.

2103.—CLEAVELAND FORBES DUNDERDALE, of New York City, in the state of New York, in the United States of America, for "*An improved apparatus for generating hydrogen gas, and for carburetting hydrogen gas or atmospheric air for illuminating and other purposes.*" Patent dated July 12, 1869.

The nature of this invention consists in the arrangement and construction of an apparatus wherein hydrogen gas can be generated and be carburetted by passing it through any suitable hydrocarbon liquid so arranged that the diluted acid by or from which the hydrogen is generated and the hydrocarbon liquid are either arranged in separate chambers, or that the same are in different compartments separated from each other, but within and under the same gas-holder.

And further, the invention consists in arranging a carburetter attached to chandeliers, pendants, brackets, or other gas fixtures, and which is so constructed and arranged that the air to be carburetted is made to pass through a hydro-carbon liquid contained in the vessel attached to the fixture, and may be heated by the flame which it is intended to feed.

2105.—CHARLES CHAPMAN, of Salford, in the co. of Lancaster, engineer, for "*Improvements in the application of pumps to artesian wells.*" Provisional protection only obtained. Dated July 13, 1869.

The improvements consist in the employment of a pipe or a series of pipes rather more in diameter than the bore-hole of the artesian well, and this pipe or series of pipes is forced into the bore-hole until the lower end of the pipe is forced into the rock or water-bearing strata. To the upper end of the pipe is connected a pump or pumps of any description, whereby the water is drawn direct from the artesian well.

2116.—ISHAM BAGGS, of High Holborn, in the co. of Middlesex, for "*Improvements in the generation and treatment of ammonia.*" Provisional protection only obtained. Dated July 14, 1869.

This invention consists in subjecting to destructive distillation organic and nitrogenous matters, including shoddy waste and the organic substances contained in sewage, and mixing or bringing the same into contact by any convenient means with the fixed alkalies and alkaline earths in a separate or combined state, and in afterwards recovering the alkali therefrom by means of combustion or lixiviation, and causticizing the same so as to use it over and over again for the like purposes.

2151.—FRANCIS GEORGE FLEURY, of Merrick Square, Southwark, in the co. of Surrey, engineer, for "*Improvements in apparatus for drawing or raising and forcing liquids.*" Provisional protection only obtained. Dated July 16, 1869.

This invention, which has for its object improvements in apparatus for drawing or raising and forcing liquids, relates to apparatus of that class in which the liquid is set in motion by the action of jets of steam, and consists in the employment of involute or other chambers, each provided with a number of small tangential or inclined slits or passages, through which jets of steam are projected into the chambers, so as to draw or raise the liquid into the same, and by the successive action of the jets of steam upon the passing liquid to force or propel it at a considerable velocity from the chambers, which for these purposes are to be provided with suitable suction and delivery pipes or tubes, as is well understood.

2152.—RICHARD BROWN EVERED, of 28, Drury Lane, brassfounder, and RICHARD HURST, of 191, High Holborn, both in the co. of Middlesex, for "*Improvements in apparatus for raising, forcing, and regulating the flow of water.*" Patent dated July 16, 1869.

According to this invention a vessel is employed which by preference is cylindrical in form and mounted vertically. It is closed at the bottom, and within it is another cylindrical vessel of smaller dimensions, which is fitted at the bottom with a perforated metal plate covered with a flexible disc acting as an outlet-valve. At the top of this cylinder is fixed a metal cap having a stuffing-box, through which works a piston-rod with a perforated metal piston upon it fitted to the cylinder and working within it.

2153.—ALEXANDER ROLLASON, of 123, Pembroke Road, in the parish of Clifton, in the city and co. of Bristol, chemist, for "*Improvements in the mode of extracting ammonia, purifying gas liquor, and utilizing the same.*" Patent dated July 16, 1869.

The object of this invention is to extract from ammoniacal gas liquor the ammonia contained therein, and cause the latter to combine with acids or other substances, so that it may be employed for manure or various other useful purposes. To this end ordinary gas liquor (ammoniacal liquor) is placed in a suitable closed vessel, in which it is subjected to heat either by means of a fire-box, a steam-chamber, or steam-pipes, or steam is injected into it to obtain the necessary heat, which may be raised to 212° Fahr. There may be put into the liquor hydrated lime, oxide and sulphate of iron, or any other of the purifying substances used by gas-makers for removing sulphuretted hydrogen. These substances by the application of heat would also assist in eliminating the ammonia from the gas liquor. If lime only be used in the boiling or heating, and if after boiling the liquor is no longer acted upon by acid, this residual liquor is purified by adding reagents, such as sulphate of iron, until no more precipitate is thrown down. After settling down the clear liquor will be quite free from disagreeable odour or injurious properties, and may be used as ordinary water in gas-works or it may be thrown away as sewage, and the precipitate will be available as a pigment. If oxide or sulphate of iron be used in the boiling, it would require from 2 lbs. to 20 lbs. for 20 gallons, according to the strength of the liquor. The iron compounds would be precipitated spontaneously and be available as pigments, while the clear liquor, being also inodorous, would be used in the works or thrown away. The ammonia which would arise from the liquor will be taken up or neutralized by preparations which are made for purifying coal gas, and for which letters patent were obtained by the present patentee, dated August, 1868 (No. 2598). Preparations made of sawdust, spent tan, shoddy, and such like materials, mixed with sulphuric acid, are used in the same proportions as named in the said patent, which preparations are placed on trays like lime in a gas-purifying box, or they may be placed in a revolving cylinder. These trays or cylinder may be either immediately over the boiling liquor, or they may be arranged apart from it, care of course being taken that by water, or other suitable luting, none of the ammonia, as it rises from the boiling liquor, be allowed to escape.

Or in place of using any of the foregoing absorbents, acids (sulphuric or hydrochloric) simply are used, which would either be highly concentrated or diluted as required, and which would be placed on leaden or other trays or shelves, and also enclosed in a gas-proof chamber, which would be capable of resisting internal pressure.

2163.—DANIEL NATHAN DEFRIES, of the Metropolitan Works, Euston Road in the co. of Middlesex, for "*Improvements in gas-meters.*" Provisional protection only obtained. Dated July 17, 1869.

These improvements consist in causing the gas, in its passage from the inlet of the meter to the measuring compartments, to pass a valve which is controlled by a flexible diaphragm or other surface exposed to the pressure of the gas. The valve opens by its own weight, or it may be by a supplemental weight or spring, and it is connected to the flexible diaphragm or surface in such manner that the pressure of the gas on the diaphragm or surface tends to lift the valve towards its seat and so reduces the size of the passage for the gas in proportion to the increase of pressure.

2186.—THOMAS HOLT, of Rochdale, in the co. of Lancaster, for "*Improvements in apparatus for supplying and distributing disinfectants to closets and similar purposes.*" Provisional protection only obtained. Dated July 20, 1869.

One of the disinfectants employed consists of fine ashes mixed with any well-known efficient disinfecting powder, and this compound is placed in a hopper or box at the back of the seat. At the bottom of the hopper there is a circular brush having at the front an elastic plate or board, and when the brush is turned the disinfectant is spread over and upon the ejected matter in the tub or in the open privy.

2203.—JOHN OGDEN, of Manchester, in the co. of Lancaster, mechanic, for "*A combined tap and filter for water and other liquids.*" Provisional protection only obtained. Dated July 21, 1869.

This invention consists in making the tap of such shape and size that the water or other liquid passing through it shall be conducted through a block of carbon or other substance to filter it.

2233.—THOMAS BARNES, of Whitehaven, in the co. of Cumberland, merchant, for "*Improvements in the treatment of coal for the removal of the sulphur compounds contained therein.*" Patent dated July 22, 1869.

The object of this invention is the removal of sulphur compounds from coal, either in its raw or natural state, or while being carbonized, in order to fit them the better for manufacturing and domestic use. This end is attained by applying to the coal, in the presence of heat, chlorine, either in the form of gas, or in chemical combination with other substances not injurious to the coal or coke, and capable of yielding the chlorine in a gaseous form under the action of heat.

In carrying out this invention, the coal, whether small, or round, or crushed coal, washed or otherwise, is placed in a tank composed of wood, or metal, or fire-brick of any suitable form or dimensions, and there is mixed with the mass of coal, say, chloride of sodium, or chloride of manganese, or chloride of iron, in proportions varying according to the ascertained quantity of sulphur compounds contained therein. Steam is then injected into the tank from a boiler placed contiguous thereto, which causes the evolution of chlorine gas, which so operates on the sulphurous matters as to volatilize and remove them, the same passing off in a gaseous state; or chlorine gas is introduced directly into the tank containing the coal, evolving it from a retort conveniently situated thereto, the gas passing through apertures or perforations situated at or near to the bottom of the tank or vessel containing the coal. The gas diffusing itself throughout the mass, in combination with steam, will so act on the sulphur compounds as to remove them without the coal being carbonized. Or instead of acting upon raw coal, sulphur compounds are removed from coal during the process of coking or carbonizing in the manner or manners following, that is to say:—The coal is placed in any of the conditions or states mentioned in the first-described mode of treatment in a coking oven or kiln, and there is mixed with the mass of coal any dry chloride or solution thereof. The mass is then fired, and at intervals or continuously steam

is injected in the manner above stated, or chlorine gas is introduced in combination with steam directly into the carbonizing mass through perforations or apertures as aforesaid, the gas being evolved from a retort situated near to the said oven or kiln, and the removal of sulphur from coal is thus effected during the process of coking or carbonizing, the same passing off in the form of vapour, suitable ventilation being provided in the oven or kiln for that purpose.

2240.—JOHN HENRY JOHNSON, of 47, Lincoln's Inn Fields, in the co. of Middlesex, gentleman, for "*Improvements in the joints of pipes and tubes.*" A communication. Patent dated July 23, 1869.

According to this invention it is proposed to cast the sockets with a screw thread on their external surface, and to employ nuts having corresponding screw threads cast in them which are screwed on to the sockets. Space is left between the outer surface of the pipes and the inner surface of the socket for the introduction of packing, which may be composed either of a washer or collar of lead alone, of india-rubber or tow, or of a leaden washer in combination with india-rubber or tow.

2249.—RAOUL PICTET, of 4, Rue Jean Goujon, in the city of Paris, France, engineer, for "*Improvements in the building of pumps in general, which permit their working without pistons and oil.*" Provisional protection only obtained. Dated July 24, 1869.

In carrying out these improvements it is proposed to employ two cylinders of cast or wrought iron, connected by a conduit to a metal candle bearing. A second and thinner one serves to support the lower part of a bellows, whose folds are maintained internally by metal rings. At the upper part of the first cylinder a metal float is arranged, which rises and falls therein. Two tubes arranged in the cover of the first cylinder terminate in two inverse valves. Between these a small glass tube is placed, in which a ball or disc rises and falls, and to which a shaft is connected as well as to the float, a spring being placed above the disc, so that the rising and falling of the float is indicated by the disc.

2264.—BRISTOW HUNT, of 1, Serle Street, Lincoln's Inn, in the co. of Middlesex, gentleman, for "*Improvements in valves.*" A communication. Patent dated July 26, 1869.

This invention consists in the employment of a heavy plate with circular vertical ends, the upper portion of which is produced with two concave curved faces, the lower portion forming a straight surface. This plate forms the valve, and vibrates within a sliding block, which latter moves, and fits snugly within the valve-chest. The sliding block is provided with suitable ports, which correspond to those in the valve-chest. The invention consists also in the valve-stem acting on a double-arm lever (the longer or upper arms being provided with friction rollers), which, by supporting the under surface of the valve, holds or raises the same, and the sliding block (by being operated by the valve-stem) towards the centre of the sliding block.

2269.—JOHN HENRY JOHNSON, of 47, Lincoln's Inn Fields, in the co. of Middlesex, gentleman, for "*Improvements in the treatment of nightsoil and other waste products, and for the manufacture of manure therefrom.*" A communication. Patent dated July 26, 1869.

This invention consists, first, in heating the evaporating cistern simultaneously from the under surface thereof. Second, in the combination with a cistern, heated as above set forth, of mechanical stirrers. Third, in drawing off the vapours from the cistern as well as the smoke or products of combustion from the furnaces employed in conjunction with such cistern, or used for other purposes, by means of an exhaust and discharge fan, and discharging such vapours or smoke or products of combustion into condensing tanks, whereby the use of a chimney is dispensed with, and the ammoniacal liquor may be utilized.

APPLICATIONS FOR LETTERS PATENT.

1999.—WILLIAM EDWARD GEDGE, of the firm of John Gedge and Son, of 11, Wellington Street, Strand, in the co. of Middlesex, patent agent, for "*An improved method of incorporating metal and cement in the construction of tanks, boxes, vases, or pots for horticultural and other purposes, water and other pipes and conduits, artificial ponds, reservoirs, basins, and rivulets, embankments of watercourses, and analogous works.*" A communication. July 15, 1870.

2024.—WILLIAM SLEIGHT BENTLEY, gas-fitter, and WILLIAM ISHAM, mechanic, both of Boston, in the co. of Lincoln, for "*Improvements in apparatus for economizing and purifying gas.*" July 18, 1870.

2032.—HENRY MALCOLM RAMSAY, of 2, Russell Villas, Twickenham, in the co. of Middlesex, civil engineer, for "*Improvements in the treatment of sewage or other liquids or solutions, and the production therefrom of manurance precipitates or other solids, as also for raising sewage or other liquids or matters by floating tanks or by the action of tidal waters.*" July 19, 1870.

2034.—SAMUEL NORTON, of the firm of Norton and Co., of Stockport, in the co. of Chester, patentees manufacturers, for "*Improvements in valve-taps.*" July 19, 1870.

2041.—HENRY REDFERN, of the town and co. of the town of Nottingham, manufacturer of ball-valves, for "*Improvements in the manufacture of ball-valves for supplying water-cisterns and tanks.*" July 20, 1870.

2047.—JOHN HUGHES LLOYD, M.D., of Llangefni, in the co. of Anglesey, North Wales, for "*Improvements in utilizing and deodorizing sewage matters of dwelling-houses and other places, and in apparatus to be used in connexion with the same.*" July 20, 1870.

2057.—THOMAS ALFRED WARRINGTON, of 8, Duke Street, Adelphi, in the parish of St. Martin's-in-the-Fields, civil and mechanical engineer, for "*Improvements in ventilators.*" July 21, 1870.

2063.—JABEZ JOSEPH MARRIOTT SILLS, of the town and co. of the town of Nottingham, tin, iron, and zinc plate worker and portable closet manufacturer, for "*An improved combined portable water-closet, night commode, and chamber pail.*" July 21, 1870.

2071.—THOMAS HIGGS and JOHN ELLIOTT, of Holborn, in the co. of Middlesex, for "*Improvements in gas regulators.*" July 22, 1870.

2074.—WILLIAM JAMES JOHNSON, of Allendale, in the co. of Northumberland, for "*Improvements in apparatus for condensing metallic and other fumes, gases, and smoke.*" July 23, 1870.

2075.—RICHARD BAILEY, of Barrow-in-Furness, in the co. of Lancaster, schoolmaster, for "*Improvements in ventilating and heating rooms and other places, and apparatus therefor.*" July 23, 1870.

2081.—HENRY DOULTON, of High Street, Lambeth, in the co. of Surrey, for "*Improvements in stop-valves.*" July 23, 1870.

2083.—WILLIAM EDWARD NEWTON, of 66, Chancery Lane, in the co. of Middlesex, civil engineer, for "*Improvements in apparatus for the manufacture of gas.*" A communication. July 23, 1870.

2117.—ANTHONY GAPPER SOUTHBY, of 3, New Inn, Strand, London, for "*Improvements in cooking by gas.*" July 28, 1870.

2120.—ROBERT BOYLE, of Glasgow, in the co. of Lanark, N.B., artist, for "*Improvements in ventilators.*" July 28, 1870.

GRANTS OF PROVISIONAL PROTECTION.

1849.—SAMUEL NORTON, of the firm of Norton and Co., of Stockport, in the co. of Chester, patentees manufacturers, for "*An improved and combined hydraulic filter and double valve-tap.*" June 29, 1870.

1883.—GEORGE SCOTT, of 33, Church Street, Chelsea, and HENRY YOUNG, of Oakley House, Manor Street, Chelsea, both in the co. of Middlesex, for "*Improvements in means or apparatus for measuring the flow or passage of liquids, which improvements are also applicable to obtaining motive power.*" July 2, 1870.

1889.—AMBROSE MARRIOTT, of Higham Ferrers, in the co. of Northampton, agricultural engineer, for "*Improvements in the construction and regulation of boilers for heating buildings.*" July 4, 1870.

1947.—THOMAS BRUCE, of Monkton, in the co. of Ayr, N.B., for "*Improvements in pumping or forcing apparatus for hydraulic presses, and for compressing or exhausting elastic fluids.*" July 9, 1870.

1952.—WILLIAM MARRIOTT, of Huddersfield, in the co. of York, for "*Improvements in the manufacture of iron salts or compounds, and in the purification of gas.*" July 9, 1870.

1967.—BRISTOW HUNT, of 1, Serle Street, Lincoln's Inn, in the co. of Middlesex, gentleman, for "*Improvements in the process of and apparatus for carburetting gases or atmospheric air, so as to render the same applicable for lighting, heating, or producing motive power.*" A communication. July 12, 1870.

1976.—WILLIAM COWLEY, of Liverpool, in the co. of Lancaster, for "*Improvements in the apparatus for pumping and forcing air and other fluids, and which apparatus is peculiarly applicable to desiccating, the ventilation of mines, buildings, ships, and other structures, and for blast and other purposes.*" July 13, 1870.

1988.—WILLIAM EDWARD NEWTON, of 66, Chancery Lane, in the co. of Middlesex, civil engineer, for "*Improvements in counting registers, applicable to counting the revolutions of shafts in various kinds of machinery, steam and other engine indicators, for registering stroke or travel, indicators for gas or water meters, clocks, adding machines, and registering devices of different kinds, or for various purposes.*" A communication. July 14, 1870.

1999.—WILLIAM EDWARD GEDGE, of the firm of John Gedge and Son, of 11, Wellington Street, Strand, in the co. of Middlesex, patent agent, for "*An improved method of incorporating metal and cement in the construction of tanks, boxes, vases, or pots for horticultural and other purposes, water and other pipes and conduits, artificial ponds, reservoirs, basins and rivulets, embankments of watercourses, and analogous works.*" A communication. July 15, 1870.

2024.—WILLIAM SLEIGHT BENTLEY, gas-fitter, and WILLIAM ISHAM, mechanic, both of Boston, in the co. of Lincoln, for "*Improvements in apparatus for economizing and purifying gas.*" July 18, 1870.

2032.—HENRY MALCOLM RAMSAY, of 2, Russell Villas, Twickenham, in the co. of Middlesex, civil engineer, for "*Improvements in the treatment of sewage or other liquids or solutions, and the production therefrom of manurance precipitates or other solids, as also for raising sewage or other liquids or matters by floating tanks or by the action of tidal waters.*" July 19, 1870.

2034.—SAMUEL NORTON, of the firm of Norton and Co., of Stockport, in the co. of Chester, patentees manufacturers, for "*Improvements in valve-taps.*" July 19, 1870.

2048.—CHARLES BARTHOLOMEW, of Doncaster, in the co. of York, for "*Improvements in treating sewage, and in manufacturing manure.*" July 20, 1870.

NOTICES TO PROCEED.

655.—GEORGE ELLIOTT, of 23, Great George Street, in the co. of Middlesex, M.P. for North Durham, for "*Improved means of ventilating and reducing the temperature of rooms or apartments in vessels, buildings, and other structures.*" March 5, 1870.

682.—ROBERT ARTHUR WIFFEN, of Romford, in the co. of Essex, plumber, for "*A new construction of tapping-cock or apparatus for drawing liquids from casks or other vessels.*" March 8, 1870.

726.—CHARLES JACKSON, of Birmingham, in the co. of Warwick, machinist, for "*Improvements in vulcanizers or apparatus employed in vulcanizing india-rubber, which improvements may also be applied to the regulation of the flow of gas for various purposes.*" March 11, 1870.

1682.—BRISTOW HUNT, of 1, Serle Street, Lincoln's Inn, in the co. of Middlesex, gentleman, for "*An improved joint for water, gas, and steam pipes.*" A communication. June 11, 1870.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2022.—FREDERICK HOLMES, "*Improvements in pumps.*" July 10, 1867.

2045.—FREDERICK WILKINS, "*Improvements in apparatus for producing or increasing the light or heat from carbonized atmospheric air, gas, or gaseous mixtures, by the use of hydrocarbons, oils, spirits, or other inflammable liquids, or any mixture thereof.*" July 12, 1867.

2124.—ARNOLD BUDENBERG, "*Improvements in joints of pipes or tubes.*" July 20, 1867.

2125.—WILLIAM TAYLOR, "*Improvements in pipes for ventilating, heating, and vaporizing hothouses, malthouses, and other buildings and residences.*" July 20, 1867.

2130.—JAMES HOOPER, "*Improvements in ventilators.*" July 20, 1867.

2133.—HENRY LEA, "*Improvements in taps or valves.*" July 22, 1867.

PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1681.—CHRISTIAN SCHIELE, "*Improvements in turbines.*" July 7, 1863.

1818.—ROBERT WEARE, "*Improvements in water-closets, commodes, slop-pails, and other like apparatus or utensils.*" July 20, 1863.

1820.—FREDERICK LUDWIG HAHN DANCHELL, "*Certain improvements in apparatus for purifying water.*" July 21, 1863.

THE

DUKE OF HAMILTON'S

LESMAHAGOW

CANNEL COAL.

LESSEES:

THE NITSHILL & LESMAHAGOW COAL COMPANY.

OFFICE:

37, ST. VINCENT PLACE,

GLASGOW,

Where all communications are requested to be addressed.

Share List of Metropolitan Gas Companies.

Number of Shares issued.	Amount per Share.	Name of Company.	Amount paid up p. Share.	Dividend p. Cent. p. Annum.	Latest Quotations.
	£		£ s. d.	£ s. d.	£
8000	10	Anglo-Romano	10 0 0	10 0 0	11 — 12
5000	20	Bahia (Limited)	20 0 9	3 0 0	13 — 14
1000	20	Do., preference	20 0 0	10 0 0	25 — 27
750	20	Do., do., redeemable	20 0 0	10 0 0	20 — 22
40000	5	Bombay (Limited)	5 0 0	4 10 0	5⅞ — 6
10000	5	Do., third issue	4 0 0	4 10 0	4½ — 4¾
10000	20	British (Limited) (Norwich, Hull-Sculcoates, Hanley, Tunstall & Shelton [Potteries], Trowbridge, & Holywell.)	20 0 0	10 0 0	30 — 31
7500	20	Cagliari (Limited)	20 0 0	7 0 0	
112000	10	*Chartered*, A shares	10 0 0	8 0 0	6½ — 6¾
8000	10	Do., do.	5 0 0	8 0 0	6¼ — 6½
10000	10	Do., B shares, 4 per cent. max.	10 0 0	4 0 0	6½ — 7
25000	10	Do., 5 per cent. preference	2 0 0	5 0 0	3 — 3½
10000	20	*City of London*, A shares	20 0 0	9 0 0	24 — 26
10000	10	Do., B shares	10 0 0	4 0 0	6¾ — 7
9629	10	Do., new shares	10 0 0	9 0 0	12½ — 13
17490	25	*Commercial*	25 0 0	10 0 0	41 — 42
20000	20	Continental Union	20 0 0	8 0 0	27¼ — 28
10000	10	Do., new	5 0 0	..	9 — 9½
5213	20	Do., preference	20 0 0	7 0 0	25 — 26
5000	10	*Crystal Palace District*	10 0 0	10 0 0	16 — 16½
5000	10	Do., preference	10 0 0	6 0 0	11 — 11¼
10000	10	Do., new shares	10 0 0	7 0 0	12 — 12½
4000	50	*Equitable*	50 0 0	10 0 0	82 — 84
4000	25	Do., new shares	25 0 0	10 0 0	41 — 42
23406	10	European (Limited)	10 0 0	11 0 0	18 — 18½
12000	10	Do., new shares (Boulogne, Amiens, Rouen, Caen, Havre, & Nantes.)	5 0 0	11 0 0	10 — 10½
20000	10	*Great Central Gas Consumers*	10 0 0	..	19 — 20
5000	10	Hong Kong (Limited)	10 0 0	9 0 0	11 — 12
26000	50	*Imperial*	50 0 0	10 0 0	84 — 85
26000	10	Do., new shares	7 0 0	10 0 0	12¼ — 13
26000	12½	Do., new shares	12 10 0	7 0 0	15 — 15¼
1300	100	Do., bonds	£100	10 0 0	175 —180
56000	50	*Imperial Continental* (Amsterdam, Berlin, Ghent, Hanover, Lille, Rotterdam., Aix-la-Chapelle, Antwerp, Bordeaux, Brussels, Cologne, Frankfort-on-Maine, Haarlem, Stolberg, Toulouse, & Vienna.)	43 15 0	9 2 6	62 — 63
400	100	Imperial Mexican (Limited)	100 0 0	nil.	
200	100	Do., new	100 0 0	nil.	
3000	40	*Independent*	40 0 0	10 0 0	6¼ — 6⅝
3000	10	Do.	10 0 0	5 0 0	7 — 9
3000	20	Do.	15 0 0	7 10 0	17 — 18
7133	50	*London*	50 0 0	10 0 0	82 — 84
5610	25	Do., 1st preference	25 0 0	6 0 0	28 — 30
503	50	Do., 2nd preference	50 0 0	6 0 0	
214	50	Do., 3rd preference	50 0 0	6 0 0	
£18781		Do., 1st preference stock		6 0 0	
£11828		Do., 2nd preference stock		5 0 0	
		Nictheroy, Brazil (Limited)			
15000	5	Malta and Mediterranean (Limited)	5 0 0	4 10 0	3¼— 4
6000	5	Do., preference	5 0 0	7 0 0	4¾— 5¼
30000	5	Oriental (Calcutta)	5 0 0	10 0 0	8 — 8½
30000	5	Do., new shares	1 10 0	10 0 0	3 — 3¼
10000	5	Ottoman (Limited)	5 0 0	nil.	2 — 2¼
14000	10	Parà (Limited)	10 0 0	10 0 0	10 — 11
27000	20	*Phœnix*	20 0 0	10 0 0	32½— 33
3600	100	Do., new	40 0 0	7 10 0	46 — 46½
144000	Stk.	Do.	100 0 0	5 0 0	83 — 86
5000	20	*Ratcliff*	20 0 0	10 0 0	27 — 28
	20	Rio de Janeiro (Limited)	20 0 0	10 0 0	28½— 29
6959	5	Singapore (Limited)	5 0 0	5 0 0	
2000	5	Do., preference	5 0 0	7 10 0	
1500	32½	Shanghai	32 10 0	12 0 0	
4000	50	*South Metropolitan*	50 0 0	10 0 0	85 — 87
4000	12½	Do.	12 10 0	10 0 0	20 — 22
20000	12½	Do., new shares	1 0 0	10 0 0	3⅞— 4¼
15000	10	*Surrey Consumers*	10 0 0	10 0 0	.. — 16
10000	10	Do., new	6 0 0	10 0 0	10 — 10½
9000	4	United General (Limerick)	4 0 0	5 0 0	2¼ — 2½
1500	10	*Wandsworth and Putney*	10 0 0	10 0 0	10 — 12
1500	10	Do.	10 0 0	7 10 0	
1819	10	Do.	10 0 0	7 10 0	
1138	10	Do.	5 0 0	7 10 0	
20000	10	Western (Limited) A shares	10 0 0	10 0 0	17 — 17¼
10000	10	Do., B shares	8 0 0	10 0 0	14½— 15
10000	10	Do., C shares	8 0 0	10 0 0	13 — 13½
20000	10	Do., D shares	1 0 0	10 0 0	2½— 3
16000	5	*West Ham*	5 0 0	7 10 0	7 — 7⅛
551	10	West London Junction (Limited)	10 0 0	6 0 0	
520	10	Do., preference	10 0 0	6 0 0	

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1 in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	128	149	177	208 lb.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle and Middlesboro'.	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pig Iron, No. 1 (g.m.b.)	3 17 6	3 0 6	2 16 0	3 10 6	3 15 0
1¼ and 2-inch Socket-pipes	7 0 0	5 15 0	5 10 0	6 0 0	7 0 0
2½ and 3-inch ditto	6 10 0	5 5 0	5 0 0	5 15 0	6 10 0
4 and 5-inch ditto	6 0 0	4 15 0	4 10 0	5 5 0	6 0 0
6 inches and upwards ditto	5 15 0	4 5 0	4 0 0	5 0 0	5 15 0
Retorts, 1st fusion, hot blast	5 10 0	4 10 0	4 5 0	5 0 0	5 10 0
Ditto, 2nd ditto, cold ditto	6 10 0	—	—	—	6 10 0
Tank-plates, ¼ thick and above	6 0 0	5 0 0	4 15 0	5 10 0	6 0 0

WROUGHT-IRON TUBING,

Subject to 60 per cent. Discount.

	2 in.	1¼ in.	1½ in.	1 in.	¾ in.	½ in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 14 feet—per foot	1 8	1 1	0 10	0 7	0 5	0 4½
Ditto ditto, from 12 in. to 23½ in.—each	3 0	2 0	1 6	1 1	0 9	0 8
Long Screws, from 12 in. upwards	4 0	2 3	2 0	1 6	1 2	0 11
Bends and Springs	4 3	2 3	1 9	1 3	0 11	0 8
Square Elbows, equal or reducing; Round Elbows, 5 per cent. extra	3 9	2 3	1 9	1 3	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 9
Crosses, ditto, equal or reducing	4 9	3 6	3 0	2 3	1 9	1 6
Iron Cocks	20 9	13 0	10 0	7 3	5 0	3 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing Sockets, Caps, Plugs, and Nipples	1 3	0 9	0 8	0 6	0 5	0 4½
Plain Sockets	1 0	0 8	0 7	0 6	0 4	0 3
Syphons, 2-quart	15 0	14 0	13 6	13 0	12 0	—

GAS COALS.

	Per Ton.
Newcastle—Unscreened:—	6s. 6d.
Haswells, Nettlesworth Primrose, and South Pelaw	
Felling, Framwell Gate, North Pelton, Redheugh Main, Walker's Primrose, West Wear, and Whitwell Primrose	6 9
Burnhope, Craghead, Charlaw, Derwent, East Castle, Edmondsley, Eighton Moor, Hartlepool Pelaw, Holmside, Lambton's Gas, Lanchester Pelaw, Medomsley, Mickley, New Pelaw, Pelaw Main, Ravensworth, Seaham, South Moor Pelton, South Leverson, Townley Main, Tyne Main, West Pelaw, Wearmouth Hutton, and Witton	7 0
Pearith, Ravensworth Pelaw, Waldridge, West Garesfield, and West Pelton	7 3
Brancepeth, Dean's Primrose, Londonderry Gas, New Pelton, Pelton, South Pearith, Stella, Urpeth, Washington Hutton, and West Leverson	7 6
Ramsay's Newcastle Cannel	15 0
Wigan Cannel (at Liverpool)	17 0
Welsh Cannel:—	
Coppa Cannel (on rails at Birkenhead), 13s. 6d.; ditto (on rails at Connah's Quay)	13 0

Scotch Cannel, f.o.b.:—	Per Ton.	*Scotch Cannel*, f.o.b.:—	Per Ton.
Boghead—at Bo'ness, 47s. 6d.; at Leith	48s. 2d	Arniston (at Leith)	21s. 9d
Muirkirk	27 0	Wemyss (at Wemyss)	20 0
Kirkness, West (at Burntisland)	22 6	Haywood and Co.'s Haywood (at Granton)	20 0
Capeldrae, 1st quality (at ditto)	22 6	Pirnie, or Methill	17 0
Ditto, 2nd ditto (at ditto)	17 6	Lothian's Cannel (at Leith)	24 6
Cowdenbeath (at ditto)	12 0	Grange ditto (at Bridgeness)	17 6
Lochgelly (at ditto)	12 0	Kinniel ditto (at Bo'ness)	17 6
Donnibristle—at Burntisland, 12s.; at Aberdour	12 6	Myles' ditto	23 6
Auchinheath Lesmahago (at Granton)	27 0	Lochore Parrot (at Burntisland)	22 6
Nitshill and Lesmahago Coal Company (at Granton)	26 6	Lancemark (at Glasgow)	16 0
		Elphinstone Tower (at Leith)	20 0

FREIGHTS.

Coastwise—Newcastle:—	Per Ton.	*Foreign:—*	Per Keel
Chatham and Rochester . . 5s. 9d. to	6s. 3d	Barcelona	£20 0
Cork	9 6	Bordeaux	12 0
Dover, Folkestone, and Ramsgate	6 9	Boulogne and Calais	8 0
Dublin	10 0	Cadiz	12 0
Exeter Quay	9 6	Cronstadt	12 0
Ipswich	5 0	Copenhagen	11 0
London (from Leith)	8 6	Genoa	18 0
London (Pool)	5 9	Hamburg	—
Lowestoft and Yarmouth	4 6	Havre de Grace	10 0
Portsmouth & Southampton . 6s. 6d. to	7 0	Leghorn	18 0
Plymouth	8 6	Lisbon	13 0
Shoreham	7 0	Rotterdam	8 0
Whitstable . . . . 6s. 9d. to	7 0	Stettin	—
Weymouth	8 0	Trieste	20 0
		Venice	23 0

SUNDRIES.

Best Newcastle Fire-bricks, per 1000	£2 10s. to £3 15s. 0d.
Cliff's Fire-bricks (at Wortley), per 1000	2 15 0
Ingham's ditto (at Wortley), per 1000	2 15 0
Farnley Iron Co.'s Fire-bricks (at Wortley), less discount	2 17 6
Fire-clay Retorts, per foot run	0s. 6d. to 0 7 6
Tarred Rope Yarn, per cwt.	1 0 0

Advertisements.

FLETCHER, SPECK, & CO.,

CONTRACTING GAS ENGINEERS, IRON & BRASS FOUNDERS,

GLENGALL IRON-WORKS, MILLWALL, LONDON, E., and RATCLIFF FOUNDRY, COMMERCIAL ROAD EAST, LONDON, E.,

MANUFACTURERS OF

TELESCOPIC and **SINGLE GASHOLDERS, TANKS, PURIFIERS, CONDENSERS,** and every description of **GAS-MAKING APPARATUS. IRON MAIN-PIPES** supplied and laid. **RETORTS, MOUTHPIECES, RETORT-LIDS, VALVES,** and **FITTINGS.** Wrought and Cast Iron Hydraulic Mains. **LAMP-POSTS, COLUMNS, GIRDERS, BRIDGES,** &c.

CORRUGATED IRON ROOFS & BUILDINGS.

GENERAL GAS CASTINGS PROMPTLY EXECUTED.

TO GAS ENGINEERS AND MANAGERS OF GAS-WORKS.

WANTED, for a Youth 18 years of age, a SITUATION in an Engineer's Office, or in a Gas-Work where he would have an opportunity of acquiring a thorough knowledge of the profession. He has had four years practical experience in a provincial Gas-Work, and can produce first-class testimonials. Salary *not* a primary object.

Address A. B., 14, Catherine Street, HARTLEPOOL.

TO GAS COMPANIES.

WANTED, by an experienced and active Man, a re-engagement as MANAGER of a Gas-Work in a country town.

For testimonials as to ability, apply to T. ELLIOTT, 7, Mount Street, Bordsley, BIRMINGHAM.

TO GAS COMPANIES.

WANTED, an appointment to superintend the distribution of gas, main and service laying, meter-fitting, &c. Ten years practical experience in a London Company as inspector. Aged 32. Married.

Address T. H., 7, Spencer Road, KENTISH TOWN, N.W.

WANTED, a re-engagement as Working MANAGER of a Gas-Work. Thoroughly understands the making and distributing of gas, main and service laying, meter-fixing and repairing, and all the general duties required in a Gas-Work. Unexceptionable references.

Address A. B., 151, Vauxhall Bridge Road, LONDON, S.W.

WANTED, a situation as Manager, by a person of 20 years experience in the manufacture, distribution, and every matter connected with a Gas-Work. Salary not so much an object as a permanent situation. Good testimonials.

Address ENGINEER, No. 13, Simpson Street, Battersea, LONDON, S.W.

WANTED, a situation as Manager or SECRETARY and MANAGER in a Gas-Work. Has had many years experience in the erection and management of Gas-Works, and can produce testimonials and references as to character and ability.

Address A. Z., care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GAS-WORKS IN SOUTH AMERICA.

WANTED, a Working Foreman who can make Gas from Resin and other substances than coal. Salary £200 to £300 per annum.

Apply by letter, with full particulars, to WILLIAM BLEWS AND SONS, Gas Engineers, BIRMINGHAM.

THE Ventnor Gas and Water Company require a FOREMAN. He must be thoroughly competent, and of good character. The Company provide a house (all rates and taxes paid), with coals and gas free.

Applicants to state age and wages required, and to send copies of testimonials to JOHN G. LIVESAY, Secretary, the Ventnor Gas and Water Company, Ventnor, ISLE OF WIGHT.

WANTED, by the 28th of August next, a first-class WORKING FOREMAN, who must be thoroughly up to the setting and working of clay and iron retorts, to the use of an exhauster, and to the general management of a moderate-sized Gas-Yard. 15 retorts used in winter, and 5 in summer. A comfortable cottage, with coal and gas, found.

Applicants will be required to produce testimonials of character, and to state wages required.

For further particulars, apply to Mr. SEATON, the Manager, Gas-Works, LUDLOW.

SITUATION Wanted by a practical gas-fitter, aged 32, as Fitter or Inspector, or Assistant, town or country. Well up in companies work and indices. Could take the charge of a district. For several years in a London Gas Company. Good references.

Address H. H., 7, Seabrook Place White Lion Street, ISLINGTON, N.

TO PROVINCIAL GAS COMPANIES.

A MANAGER of experience requires a situation, where the make is from 10 to 50 millions per annum. Would undertake to find all labour required at a fixed sum, or make the gas at per 1000.

Address ABLE, 65, Southwark Bridge Road, LONDON, S.

TO FOREMEN GAS-FITTERS.

THE Sheffield United Gaslight Company is in want of a thoroughly competent Man as FOREMAN of GAS-FITTERS. He must be capable of arranging for the lighting of public buildings, places of worship, mansions, and large works. Also of superintending the workmen in the execution of the work.

Apply in own handwriting, with references, stating age, wages required, and where last employed, to Mr. T. ROBERTS, the Manager, Shude Hill, SHEFFIELD.

OLD GOOLE GAS-WORKS.

TO BE SOLD BY AUCTION, by Mr. NATHANIEL EASTON, at the Lowther Hotel, in Goole, West Yorkshire, on WEDNESDAY, August 17, 1870, at Three p.m. (unless sold privately in the meantime), the GAS-WORKS at Old Goole, with the Manager's house, necessary outbuildings, and large garden. These works have been erected within the last few years, regardless of expense, in a substantial and workmanlike manner, in a very thriving and increasing populous locality.

To view, apply to Mr. JAMES YOUNG, Builder, near the station, GOOLE, or to the GAS MANAGER on the premises; and for further particulars, to the AUCTIONEER, 9, Bowlalley Lane, HULL, or to BURLAND, SON, AND PETCH, Solicitors.

South Cave, July 22, 1870.

TAR AND TAR-WORKS TO BE LET.

TO BE LET by Tender, for One, Three, or Five years, from the 1st of November next, the TAR-WORKS situate in Farington, near Preston, together with Tar produced at the various works belonging to the Preston Gas Company.

Tenders, endorsed "Tender for Tar, &c.," must be delivered to the undersigned, on or before Sept. 3 next.

For further particulars, apply to HENRY GREEN, Engineer.

THE Advertiser is desirous of a situation as MANAGER or METER INSPECTOR. Is a practical fitter and meter repairer, and thoroughly understands the routine of Gas-Works. Good references.

Address ALBION, 2, Goding Street, Vauxhall, LONDON, S.W.

BATH WATER-WORKS.

CAST-IRON PIPES.

THE Corporation of the City and Borough of Bath invite TENDERS for the supply of about 2700 tons of CAST-IRON SOCKET-PIPES, of the following descriptions, viz.:—

1,320 yards of 4 inch,
770 yards of 6 inch,
6,750 yards of 8 inch,
850 yards of 9 inch,
3,320 yards of 12 inch,
10,670 yards of 18 inch,
With all branches, reducing pipes, bends, and irregular pipes.

Drawings, specifications, and terms of contract, may be seen on application to Mr. Alfred Mitchell, the Engineer, No. 3, Fountain Buildings, Bath.

Sealed tenders, endorsed "Tenders for Supply of Iron Piping," to be delivered at the Office of the Town-Clerk, Guildhall, Bath, on or before Saturday, Aug. 13 next.

The Corporation do not bind themselves to accept the lowest or any tender.

The whole of the Piping to be delivered in Bath.

By order,
ALFRED MITCHELL, Engineer.

Guildhall, Bath, July 21, 1870.

SWANSEA GASLIGHT COMPANY.

TO TAR DISTILLERS, MANUFACTURING CHEMISTS, & OTHERS.

THE Directors are prepared to receive offers from parties willing to TENDER for the purchase of the whole or portion of the surplus TAR produced at their works, for a period of Three or Five years.

Surplus quantity about 100,000 gallons per annum.

Tenders at per gallon (in the Gas Company's tanks) to be sent in to me, the undersigned, on or before the 6th day of August.

The Directors do not bind themselves to accept the lowest or any tender.

THORNTON ANDREWS, Secretary and Manager.

Swansea, July 16, 1870.

GAS AND WATER WORKS TO BE LET.

THE Milford Improvement Commis-sioners are prepared to receive TENDERS for LETTING, for a term of Five or Seven years, as shall be agreed upon, the MILFORD GAS AND WATER WORKS.

Particulars and further information may be obtained on application at the Office of the Commissioners, Milford, PEMBROKESHIRE.

Sealed tenders to be sent to the Clerk, on or before the 10th day of August.

The Commissioners do not bind themselves to accept the lowest or any tender.

By order of the Commissioners,
THOMAS EDMOND, Clerk.

CAROLINE VICKARY,

(ADMINISTRATRIX TO THE LATE JOHN VICKARY,)

GAS ENGINEER, CONTRACTOR, IRON AND BRASS FOUNDER,

EXE ISLAND, EXETER,

(Established Thirty years,)

Respectfully tenders her thanks to those friends who have patronized her since her late husband's death, and having secured an efficient staff for each department of design and manufacture, she refers with confidence to works recently erected by her as a guarantee that all orders she may be favoured with will be completed in a sound and satisfactory manner.

GASHOLDERS AND TANKS,

Retorts, Retort-Fittings, Condensers, Scrubbers, Purifiers, Station-Meters, Governors, Sluice-Valves of all kinds. (Gas and Water Mains always in stock.)

GAS-FITTINGS,

Including Chandeliers, Pendants, Hall Lamps, Brackets, Star and Sun Lights of all designs, embracing the Mediæval and other periods.

GAS-METERS (WET OR DRY),

Combining the most recent improvements in principle and manufacture; upwards of 150,000 already in work, giving the highest satisfaction. (A guarantee for five years given with each one.)

Every description of **Plumbers Work,** comprising **Water-Closets, Beer-Engines, Lift and Force Pumps, Cocks for Gas, Water, or Steam, &c.**

Drawings, Specifications, and Estimates of **Gas-Works, Iron Roofs, Bridges,** and light or heavy structures in wrought or cast iron, supplied on application.

1862.

PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

CLASS II.

This Paint having been in general use over eight years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

LAMBERT BROTHERS, WALSALL.

ALPHA TUBE & FITTING WORKS

GEORGE NEWTON,

UNION STREET WEST, OLDHAM,

MANUFACTURER OF

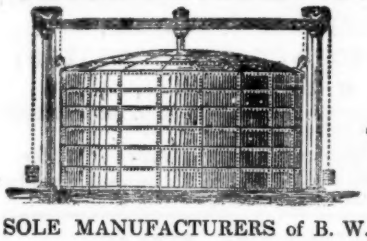
IMPROVED WET & DRY CONSUMERS GAS-METERS,

GAS STATION-METERS,

With all the Joints planed,

GOVERNORS, GAUGES, INDICATORS, EXHAUST GOVERNORS, &c.

TERMS, &c., ON APPLICATION.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

LONDON OFFICES—57, GRACECHURCH STREET, CITY.

*** *Please address letters to Huddersfield.*

REFERENCES TO NEARLY 300 GAS-WORK

CATHELS & TERRACE'S

PATENT FOUR-WAY DISC GAS-VALVE

(Being a simplification and improvement of Cathels's well-known Valve) is the best Valve for Gas-Works. It is specially applicable as a by-pass to Condenser, Exhauster, Scrubber, Station-Meter, &c., as, having no springs, ground faces, or other delicate complications to be affected by crude gas, it NEVER SETS FAST. When applied to Purifiers, the utmost facility of change is afforded; the direction of the flow of the gas is seen at a glance, and no unpurified gas can pass into the holders at each change, as happens with Centre-Valves. In either application ONE VALVE SERVES AS THREE OTHER VALVES. The opening and closing are now effected by one movement, and the ports being all on the same level, enables the connexions to be simple lines of straight piping. The closing of one gas-way opens another, preventing the possibility of accidentally stopping back the gas. The Valve has been in general use for upwards of five years, with the most satisfactory results, and is so simple and strong that it may be considered indestructible.

Illustrated Circular, Prices, &c., on application to the Makers,

Messrs. GUEST & CHRIMES,

FOUNDRY AND GENERAL BRASS-WORKS,

ROTHERHAM.

CANNEL COAL.—The West Yorkshire Iron and Coal Company, Limited, beg to draw the attention of Gas Companies to their Cannel, of which the following is the analysis made by W. Huggon, Esq., F.C.S.:

Yield of gas per ton	10,296 cubic feet.
Illuminating power rather over	21 sperm candles.
Yield of coke per ton . . .	12 cwt.

The actual working, as reported by one of the largest gas companies in Yorkshire, gives results still more favourable, viz.—

Yield of gas	10,416 cubic feet.
Illuminating power	21·89 sperm candles.
Coke	The same.

We add from the same source the capabilities of the common gas coal—

Yield of gas	10,080 cubic feet.
Illuminating power	14·41 sperm candles.
Yield of coke	13 cwt.

COLLIERIES—WEST ARDSLEY, near LEEDS.

For further particulars, address to the Office of the Company, 15, York Place, LEEDS.

POPE & PEARSON'S GAS COAL.—We have now the authority of several of the most eminent Gas Engineers of London in stating that our Coal yields *in practical working over* 10,000 *cubic feet of gas, with an illuminating power of* 16 *candles.*

One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

For further particulars, apply to POPE AND PEARSON, West Riding and Silkstone Collieries, near LEEDS.

OLD WEMYSS CANNEL COAL.—Yield of gas per ton, 12,896 cubic feet; illuminating power, 31·75 standard candles. Port of shipment, Wemyss.

Analysis and price on application to Mr. WM. CAREY, Manager, Wemyss Colliery, Kirkcaldy, FIFE.

CANNEL COAL.

MESSRS. GRIFFITHS BROTHERS,
COPPA COLLIERY, MOLD,

Beg leave to call the attention of Gas Companies to the superior quality of their Cannel for gas-making purposes.

This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

Ports of shipment—Birkenhead or Connah's Quay.

Waggons supplied for delivery by railway to any part of England or Wales.

For particulars, prices, and rates of freight, apply to GRIFFITHS BROTHERS, Coppa Colliery, Mold, FLINTSHIRE.

THE
HUCKNALL COLLIERY COMPANY
Can offer a CANNEL COAL yielding a large quantity of Gas of superior quality.

Prices and information on application to the HUCKNALL COLLIERY COMPANY, Hucknall Torkard Collieries, near NOTTINGHAM.

THOMAS EDINGTON & SONS,
PHŒNIX IRON-WORKS,
GLASGOW,
Manufacturers of all kinds of
GAS AND WATER PIPES,
Branches, Bends, Water-Traps, Tank-Plates, Valves, and general Castings. Also
RAILWAY CHAIRS & SLEEPERS,
AND
GRIFFIN'S PATENT PERMANENT WAY.
London Office, 63, Old Broad Street.

WALTER MABON & CO.,
Engineers,
ARDWICK IRON-WORKS,
FAIRFIELD STREET, MANCHESTER,
MANUFACTURERS OF
IRON TANKS, GASHOLDERS.
GAS APPARATUS,
PIPES, VALVES, IRON ROOFS,
WROUGHT AND CAST IRON GIRDERS.
DESIGNS, SPECIFICATIONS, & ESTIMATES FURNISHED.

FIRE-CLAY GAS-RETORTS, &c., CANNEL AND STEAM COALS.

WILLIAM FRASER, Inverkeithing (owner of the Works at which Fire-Clay Retorts were first made), having greatly enlarged his Works, can supply RETORTS and other FIRE-CLAY GOODS to any extent.

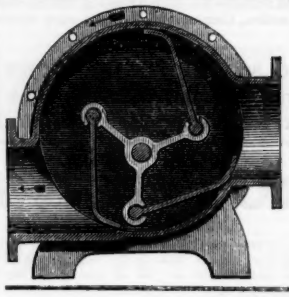
References can be given to managers of above a hundred Gas-Works whom he supplies.

WILLIAM FRASER ships COWDENBEATH PARROT COALS at Charlestown and Burntisland at 11s. per ton; and HALBEATH STEAM COALS, on Navy List, at 7s. per ton.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
good quality of Fire-Bricks.
WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

J. T. B. PORTER & CO.,
GAS ENGINEERS,
MANUFACTURERS AND CONTRACTORS FOR GAS-WORKS
Of any extent at Home and Abroad,
GOWTS BRIDGE WORKS, LINCOLN,
AND
JOHN STREET, ADELPHI, LONDON, W.C.

WALTER FORD,
159, GRAY'S INN ROAD, LONDON,
MANUFACTURER OF
WET & DRY GAS-METERS, STATION-METERS, GOVERNORS, &c.
SOLE MANUFACTURER OF
PADDON'S PATENT STREET-LAMP REGULATORS,
For ensuring any required consumption. These Regulators are in general and increasing use, and references can be given to Gas Companies who use them for every Lamp.



CHARLES HORSLEY'S
PATENT
GAS EXHAUSTER.
(From 250 Feet upwards per Hour.)
Also,
ROTARY TAR AND OIL PUMPS.
For particulars and prices apply to the Patentee,
22, Wharf Road, City Road, London, N.

ROBERT DEMPSTER,
Gas Engineer and Contractor, Rose Mount Foundry, Elland, near Halifax.

R. D. recommends his Fire-Brick Retorts to Engineers and Managers of Gas Companies; they last from 10 to 12 years.

Iron and Fire-Clay Retorts.	Wrought-Iron Tubes, Water Tanks.
Annular and Pipe Condensers.	Wrought-Iron & Cast-Iron Roofs.
Scrubbers and Purifiers, all sizes.	Gasholders, Single-Lift or Telescopic.
Steam-Engines and Exhausters.	Gas Castings of every description.
Hydraulic Centre-Valves.	Retort Setters and Fitters sent to all parts of the country.
Station-eMters and Governors.	Wood Sieves for Purifiers.
Photometers & Pressure-Gauges.	
Lamp-Posts and Brackets.	
Cast-Iron Mains and Syphons.	

Plans and Specifications prepared.

WILLEY & FORD,
GAS ENGINEERING WORKS, EXETER,
CONTRACTORS FOR THE ERECTION OF GAS-WORKS,
MANUFACTURERS OF IMPROVED WET & DRY METERS;
Also, EVERY DESCRIPTION OF GAS APPARATUS,
Comprising GASHOLDERS, STATION-METERS, GOVERNORS, CONDENSERS, PURIFIERS, RETORTS, SLIDE-VALVES, and every article appertaining to Gas-Works.
Gas Companies advised on Improvements, Extensions, and Alteration of Works.
*** The very best material and workmanship guaranteed, and at prices bearing a favourable comparison with any House in the Kingdom.

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CONTRACTING GAS ENGINEERS, &c.
MANUFACTURERS OF GASHOLDERS, TANKS, PURIFIERS,
AND ALL DESCRIPTIONS OF GAS-MAKING APPARATUS.
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MANUFACTURERS OF
CRYSTAL, BRONZED, & ORMOLU CHANDELIERS, IMPROVED CRYSTAL STAR & SUN LIGHTS, AND THE PATENT CRYSTAL ILLUMINATION;
Vestibules, Iron Barrel, Composition Tubing, Dry & Wet Meters, & Gas-Fittings
OF EVERY DESCRIPTION.
WORKS: LONDON, BIRMINGHAM, & PARIS.
REGISTERED DESIGNS.

Special Designs prepared in perfect accordance with architectural arrangements. Estimates furnished for the Lighting and Fitting up of Theatres, Music Halls, and Public or Private Buildings with Gas.

GAS MOONS of the newest designs.

The Patent Gas-Regulator and Purifier reduced to 6s. 6d. per Doz.

Pattern-Books of Gas-Fittings, Crystal and Ormolu Chandeliers for 1870, are now complete.

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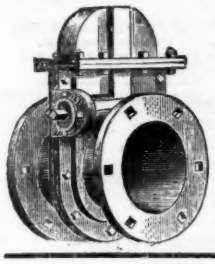
ESTABLISHED 1803.

REDUCED PRICES
OF
B. DONKIN & CO.'S
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS,
From 2 inches to 18 inches, price 9s. 6d. to 12s. per inch diameter.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.
These Valves are all proved on both sides to 30 lbs. on the square inch before leaving the works, and are always kept in stock.
VALVES MADE WITH OUTSIDE RACKS TO ORDER.
ALSO,
SCREW WATER-VALVES WITH GUN-METAL FACES.
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GENERAL ENGINEERS AND IRONFOUNDERS,
MAKERS OF STEAM-ENGINES,
BERMONDSEY, LONDON, S.E.

A. C. FRASER, F.S.A.,
GAS AND CONSULTING ENGINEER,
COLCHESTER, ESSEX,
INVENTOR & PATENTEE of CAST-IRON & FIRE-CLAY RIBBED RETORTS.
Mr. Fraser having had more than Twenty years experience in the Construction, Alteration, and Management of GAS and WATER WORKS, will be happy to furnish information on all matters appertaining thereto.
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WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.
TABLE GLASS OF ALL KINDS.
CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.

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RETORT SETTINGS, heated by tar without the production of smoke.
STEAM-ENGINES and EXHAUSTERS, separately or combined.
FOUR-WAY VALVES, one of which is equal to three ordinary Valves.
STATION GOVERNORS—the Gasholder cannot tilt and cause accident.
BREEZE AND TAR FUEL MACHINE.
A Pamphlet containing Eighteen Illustrations of the foregoing, with letterpress on the construction of Works, post free, 2s. 6d.
N.B.—The second edition of this Work, *now ready*, contains illustrations of the Machine for converting Breeze and Tar into Fuel for heating the Retorts.
"The Author is well qualified to speak authoritatively upon the important subjects to which his pamphlet refers."—*Artizan.*

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PATENT PLATINUM
GASLIGHT PERFECTER.

Extract from Report by Dr. Letheby:—
"The results have been very remarkable, for they show an average increase of 63 per cent. on the illuminating power of the gas. I am of opinion, therefore, that the invention is of great practical value."
Price 1s. each for Fishtail Burners.
To be had retail of Gas-Fitters and Ironmongers, and wholesale of
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Terms on application. N.B.—A specimen sent free on receipt of Twelve stamps.
*** Further testimonials from Drs. Frankland and Crooks, showing the great practical value of this invention, will be shortly published.

PRICE'S PATENT COKE & COAL BARROW,

effecting a great saving of time, labour, and expense.
For particulars, price, &c., apply to Mr. E. PRICE, Gas-Works, HAMPTON WICK.

HOPKINS, GILKES, & CO.,
LIMITED,
MIDDLESBOROUGH,
SUPPLY GAS & WATER PIPES of EVERY SIZE.
Plain, Turned and Bored, and Coated.
CAST-IRON RETORTS.
Castings for Gas-Works of every description.
EXHAUSTERS.
LONDON OFFICE: 95, CANNON STREET.

WATER-WORKS FITTINGS,
SLUICE COCKS, FIRE COCKS,
METERS, STEAM FITTINGS,
GAS & HOT-WATER VALVES, &c.,
Of First-class Materials and Workmanship.
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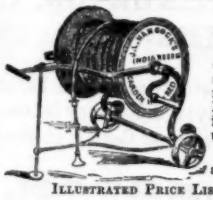
Illustrated Catalogues on application.

HANCOCK'S INDIA-RUBBER HOSE-PIPES,
FOR WATERING GARDENS, LAWNS, &c.



Made in 60 ft. lengths, and best make only.
Brass branches, with stop-cocks, jets, and spreaders, and union joints for connecting any size Hose.
HOSE REELS (galvanized iron or painted) for winding up the Hose.
Orders promptly executed, and
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NAPHTHALINE
IN GASHOLDER INLET-PIPES.
With Livesey's Patent Man-Lid these Pipes can be examined and cleansed without loss of Gas, with the greatest facility and without any risk.
Cost of the Apparatus, to cover two 18-in. pipes, about £10.
Royalty: At the rate of 1s. per foot diameter of each Gasholder, and no further payment.
LIVESEY'S SYSTEM OF WATER-VALVES
FOR PURIFIERS
Will effectually prevent that contamination of the pure Gas which so frequently occurs where the ordinary Valves are used. They are much less costly, easily applied, and, being simple castings, cannot well get out of order, while by their use it is found that the Gas will bear a continuous test for Sulphuretted Hydrogen for an indefinite time.
Application to be made to the Patentee, GEORGE LIVESEY, Engineer, South Metropolitan Gas-Works, S.E., where both inventions are in use.

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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.
Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.
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PATENTEES OF THE
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MANUFACTURE EVERY DESCRIPTION OF
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WELDED TUBE AND FITTINGS,
BLACK AND GALVANIZED;
BRASS, COPPER, LEAD, TIN, AND COMPOSITION TUBING,
STOCKS, TAPS, AND DIES,
And Every Description of Gas-Fitters' Tools;
CAST-IRON GAS-MAIN COCKS,
WITH PATENT METAL PLUGS;
GAS SLIDE AND SLUICE VALVES;
CARTER'S SAFETY GAS-VALVES,
GAS-STOVES, REGULATORS, BURNERS, &c.,
Large Pattern-Book and Price List of Gas-Fittings, price 7s. 6d., supplied on application.

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GAS AND WATER ENGINEERS,

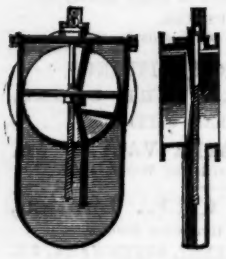
AND

CONTRACTORS FOR GAS AND WATER WORKS APPARATUS.

SHOW-ROOMS AND WHOLESALE WAREHOUSE FOR

Wrought-Iron Tubes & Fittings for Gas, Water, & Steam; Chandeliers, Pendants, Lamps and Brackets, Plumbers Work, Water-Closets, Pumps, &c. Lead, Composition, Brass, and Copper Tubes.

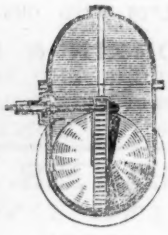
PATENTEES OF THE

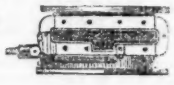


NEW FLEXIBLE VALVE

FOR

GAS & WATER WORKS.





This Valve has been designed to meet what has hitherto been felt a great want, in Gas-Works especially—namely, a *really tight* Valve which could be depended upon.

The new Valve is simple in construction, not liable to get out of order, cheap in price, and the principle can be adapted to every part of Gas Apparatus where a Valve is required.

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SOLE MANUFACTURERS OF

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With special facilities for adjusting and repair, the principal parts of the mechanism being accessible by the removal of a single screw.

Gas-Meters on the Wet and Dry principles made in Cast-Iron and Tin-Plate Cases.

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Is guaranteed to prevent and arrest Rust on all Ironwork, and to cover Tar most effectually. It is most valuable for protecting it from the action of salt water, rain, sulphurous and gaseous exhalations. It has been well tested at various Gas-Works, in covering Tar on Gasholders, Purifiers, &c., and has given great satisfaction.

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Superior Articles at reasonable prices.

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The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large Stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all Sizes kept in London at Mr. ALFRED WILLIAMS, Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

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With many recent improvements, from 1500 to 150,000 cubic feet per Hour.

JAMES BURTON, SONS, & WALLER,

MAKERS OF ENGINES, MACHINERY, and IRONWORK for GAS-WORKS,
Efficient and durable TAR, LIQUOR, and SYPHON PUMPS,
GAS-VALVES, with or without Wedges, worked with powerful Worm and Rack,
SELF-ACTING BY-PASS VALVES, with Lid and Relieving Lever,
ROTATORY, TUMBLER, and CAPILLARY WATER DISTRIBUTORS for SCRUBBERS.
SMALL-SIZE EXHAUSTERS KEPT IN STOCK.

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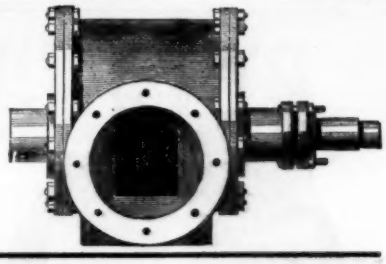
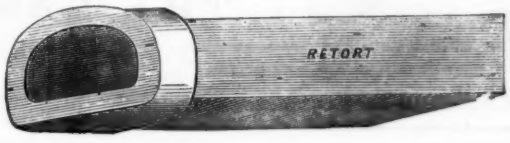


KING BROTHERS,

STOURBRIDGE FIRE-BRICK AND RETORT WORKS.



KING BROTHERS beg especially to call the attention of Gas Companies to the superiority of their Retorts, which are made from the celebrated STOURBRIDGE FIRE-CLAY. Mr. King has patented a Kiln for burning Retorts, by which Patent all Cold Air is excluded from the Kiln while burning, thus rendering them FREE FROM CRACKS AND CORRECT IN FORM. By great care in Manufacturing, combined with the advantages in burning, a VERY SMOOTH SURFACE is obtained, rendering them less liable to carbonize.

Retort Ovens, Fire-Bricks, Guards, Saddles, Rabbitted Bars, Flues, and Quarries, are all Manufactured of the same quality of Clay.

Every Retort and Brick is branded "King Brothers, Stourbridge."

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THE FARNLEY IRON COMPANY,

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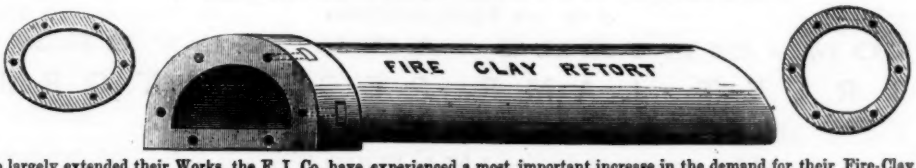

Since they so largely extended their Works, the F. I. Co. have experienced a most important increase in the demand for their Fire-Clay Retorts, which they owe chiefly to the superior quality of their make, and to the facilities they now possess for executing orders promptly, either for *home* or for *export*.

The Fire-Clay raised from the Farnley Estate (commonly called the Wortley bed) is unsurpassed by any other known in the district, and is peculiarly well adapted for Retorts, Gas-Ovens, and Fire-Bricks; and the F. I. Co. beg especially to invite those connected with Gas-Works, who have not yet used their Retorts, to be good enough to favour them with a trial.

The F. I. Co. generally hold in stock, for immediate supply, Fire-Bricks of every size and kind—Tiles, Sanitary Tubes, Ornamental Terra-Cotta Ware White Facing Bricks, the White, Buff, and other Glazed Bricks and Tiles, in various colours and shapes, &c., as well as the Brown Salt-Glazed Bricks, &c., &c.

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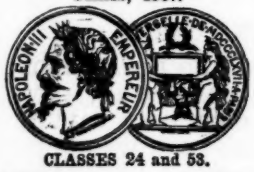

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LAMP METERS AND BOXES.

LOWE'S JET PHOTOMETERS CAN NOW BE RATED TO 14 CANDLES.

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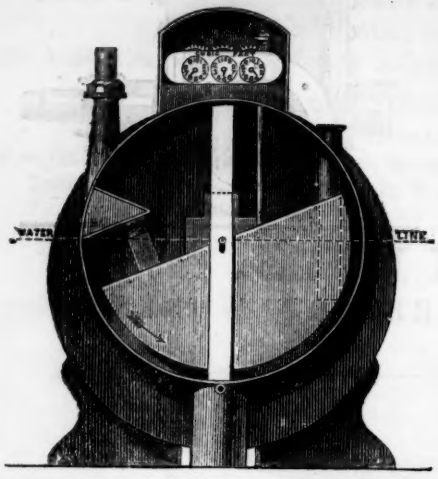
Where is always kept a Stock of Retorts, Fire-Bricks, Terra Cotta Ware, and Drain-Pipes.



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UNVARYING WATER-LINE GAS-METER.

(SANDERS AND DONOVAN'S PATENT.)

"Unquestionably the best Water Gas-Meter now in use."

Over 60,000 in action.

MANUFACTURERS:

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KINGSLAND ROAD, LONDON;

WITH

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ALEXANDER WRIGHT & CO.,

MANUFACTURERS OF

WET METERS,

COMPENSATING WET METERS,

AND

IMPROVED DRY METERS

of the very highest excellence.

STATION-METERS AND GOVERNORS.

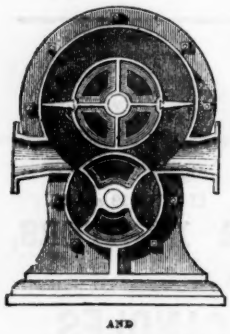
STREET-LAMP REGULATORS.

TESTING APPARATUS

of the most perfect description for all purposes relating to Gas.

55 and 55a, MILLBANK STREET, WESTMINSTER, S.W., and COPENHAGEN.

LAIDLAW'S PATENT GAS EXHAUSTER



AND

ROTARY PUMP.

R. LAIDLAW & SON,

GAS ENGINEERS, CONTRACTORS, IRON & BRASS FOUNDERS,

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